PROGRAMMABLE NOISE

GENERATING INSTRUMENT

N C 7 1 0 9

OPERATING MANUAL

NOISE COM, INC.
S/N 6001
DATE: 11/01/91

TABLE OF CONTENTS

I. GENERAL INFORMATION

1-1 Introduction

1-2 Description of the Basic Unit

1-3 Options and Optional Configurations

II. SPECIFICATIONS

2-1 Instrument Specification

2-2 Functional Specifications

2-3 Block Diagram

III. INSTALLATION

3-1 Initial Inspection

3-2 GPIB (IEEE 488 BUS) Interconnection

3-3 GPIB Address

3-4 RS 232, RS 422, RS 423 Interconnection

IV. OPERATION

4-1 Introduction

4-2 Front Panel Controls

4-3 Remote Operation

4-4 Remote Indicators

V. PERFORMANCE VERIFICATION

VI. ADJUSTMENT & CALIBRATION

VII. SERVICE

7-1 Common Parts

7-2 Parts/Model

7-3 Figures 1, 2, and 3

I. GENERAL INFORMATION

1-1 INTRODUCTION

This manual is the operation and maintenance manual for Series NC7100 and NC7900 Programmable Noise Generating Instruments. It provides general information plus installation and operation instructions.

Section I provides a description and option information for the Programmable Noise Generating Instruments.

1-2 DESCRIPTION OF THE BASIC UNIT

Noise Com, Inc. Series NC7100 and NC8200 Noise Generating Instruments are designed to supply a high level of white gaussian noise output. They can be controlled manually by means of front panel controls, or, alternately, they can be controlled remotely by means of a controller via IEEE 488 (GPIB) BUS (RS-232, RS-422 or RS-423 option available). These Instruments operate remotely only in the listen mode.

The case is 17" wide, 5.25" high and 12.5" deep. It is equipped with front panel handles and fold down feet. Rack mounting brackets for 19" rack mounting are available. Brackets are mounted at the factory.

The RF circuit, without options, contains a noise generator assembly, a standby switch, and a programmable attenuator (Fig. #1). The above circuit with all options listed in the following section (1-3) is depicted in Figure #2. The digital interface for this unit, without options, is IEEE 488 BUS (GPIB).

1-3 OPTIONS AND OPTIONAL CONFIGURATIONS

Programmable Noise Generating Instrument options include:

1. Fine resolution attenuator .1db steps 0 - 127.9DB.

2. Input Power 230V 50Hz.

3. Rack Mounting Brackets (19" x 5¼").

4. Switching bandwidth by means of band limiting filters. Frequencies to be specified by customer.

   4.1 Up to 6 filters and a filter bypass for full band operation.

   4.2 7 Filters.

5. Input connector and resistive combiner. This allows a signal, externally supplied, to be combined with the noise output. Noise output will be 6DB below standard output specified.

6. The following items may be added to Item 5: Option Items 1, 4 and a 127DB, 1DB step attenuator. All of the preceeding items are programmable. These option items will be located in the input connector arm of the RF circuit.

7. The marker input option permits injection of a signal into the output line. The marker input is decoupled approximately 23DB. Decoupled noise output is available at the marker input.

II. SPECIFICATIONS

2-1 INSTRUMENT SPECIFICATIONS

Frequency Range 100 Hz TO 1000Mz

Output 10 Mw

Output impedance 50 Ohms.

Input voltage 115 Volts 60Hz (230V 50Hz Optional).

Noise output is white gaussian noise with a qualified peak factor.

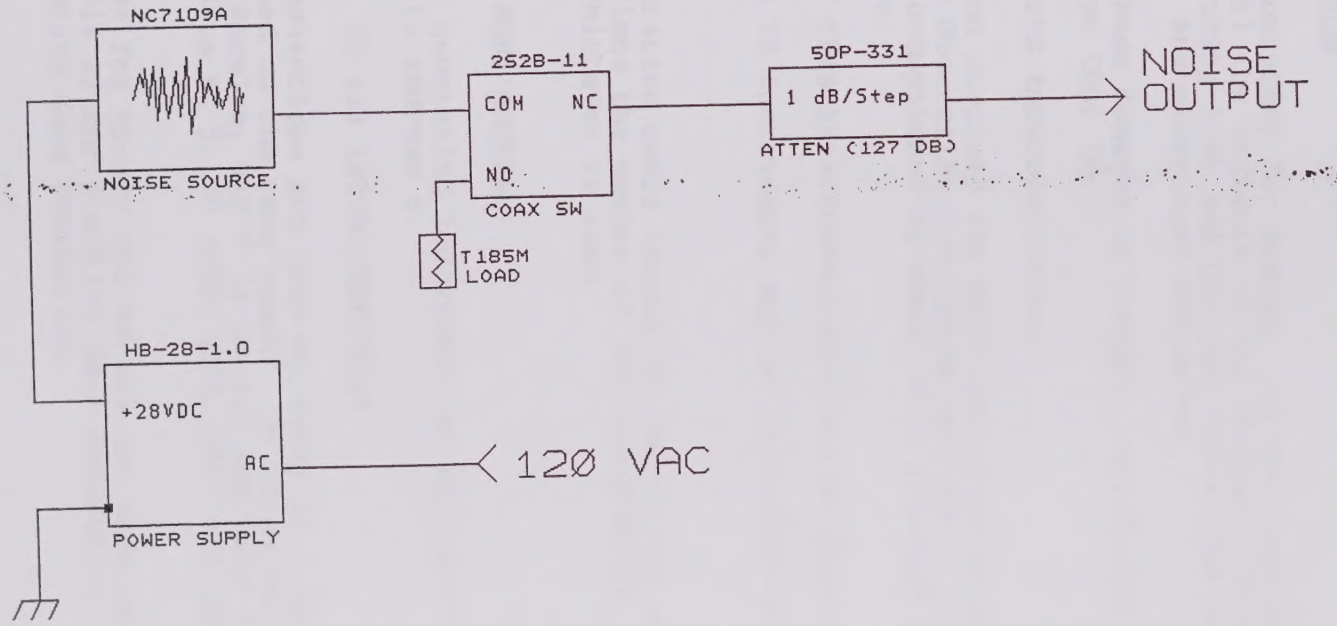
Control by means of front panel or remotely by means of a controller via IEEE (GPIB), RS-232, RS-422 or RS-423.

2-2 FUNCTIONAL SPECIFICATIONS

Non Volatile memory to retain program parameters, GPIB address, serial baud rate and user programmed control sequences

Baud Rates:	300, 1200 and 9600 to be used with optional serial interface ports.
Time Delay:	.1 to 999.9 seconds with .1 second resolution.
Programmable Attenuator:	Standard 0-127DB in 1DB steps.
Programmable Attenuator:	Optional 127.9DB in 0.1DB steps.
Bandwidth selection:	Optional band switching filter to customer specification. Consult Noise Com.
Standby Position:	Power is switched into a dummy load.
Reset:	A logic reset button is provided.
Second Output:	Optional SPDB Switch to connect either of two outputs.

BLOCK DIAGRAM
NC7109



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III. INSTALLATION

3-1 INITIAL INSPECTION

Inspect the shipping container for damage. If the container is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If the instrument has been damaged in transit, notify the carrier as well as Noise Com, Inc.

3-2 GPIB (IEEE 488 BUS Interconnection)

The only interconnection required for GPIB operation is between the Programmable Noise Generating Instrument and the controller. This is accomplished by means of a standard GPIB 24 wire interface cable.

Restrictions on use of GPIB interconnections are as follows:

1. No more than 15 Instruments may be installed on the bus.

2. Total accumulative cable length in meters may not exceed two times the number of bus instruments, or, 20 meters, whichever is less.

3-3 GPIB (IEEE 488 BUS) ADDRESS

The programmable noise generating instrument as shipped from the factory is preset to address 5.

3-4 RS-232, RS-422, RS-423 INTERCONNECTION

RS-232, interconnections are made by means of a DB25S connector mounted on the rear panel. It is wired as DTE. Pin 3 is Receive, Pin 7 is Ground and Pins 4, 5 (RTS-CSD) and Pins 6, 8, 20 (DSR, DCD, DTR) are jumper connected.

Interconnections for RS-422 and RS-423 are made as follows: Use Pin 12 for positive data connection and Pin 13 for negative data connection.

V. OPERATION

4-1 INTRODUCTION

The NOISE/COM PNGI uses a powerful single-chip microprocessor to accurately control the amplitude, bandwidth, and combining of its internal broad-band noise source and an externally applied user generated signal.

Commands to the PNGI can be entered via a front-panel telephone-type keypad. Alternately, commands can be down loaded from any computer using the GPIB (HP-IB) IEEE-488 instrumentation bus (as a talker), or by the optional RS-232, RS-422, or RS-423 adapters allowing connection to any asynchronous serial interface. A front panel numeric display and lighting status indicators give the operator visual verification of the programming process and functional state of the device.

The PNGI includes a special non volatile memory which will retain various programmed parameters after the unit has been powered-off, and restore them to the state they were in when the instrument was last used. These preserved functions include GPIB listener address, serial baud rate, and user programmed control sequences specifying attenuation levels, signal bandwidth, time delays and incremental attenuation step values.

A "Reset" button has been provided. Use of this button will return the instrument to the power turn on state. At power turn on, the programmable attenuator is at 127DB and standby is off.

To obtain output power, F10E must be entered on the keyboard. Maximum output power will then be available at the output.

4-2 FRONT PANEL CONTROLS

Programming Via the Keypad:

The PNGI can be directly programmed through the front-panel keypad (see Fig. 3) using simple data entry sequences. Internally, the PNGI may have a maximum rf circuit as follows: two identical attenuation, filtering, and standby circuits for the internally generated noise source and for an externally applied signal provided by the user. These three functions can be independently programmed for each of the two signals (see Circuit Block Diagram Fig. 2). The two circuits then combine to a single output.

Functions F1, F2 and F3 control the attenuation, increment/decrement attenuation step size and bandwidth of the noise source component of the output. Functions F5, F6 and F7 control those same functions as applied to the externally introduced signal component, programming of these parameters is accomplished as follows:

where F represents the FUNCT Key and dn represents a digit:

ATTENUATION: F1 d1 d2 d3 d4 is Programmable in the Range from 0 to 127 dB in Steps of 1dB.

If you have ordered the High-Resolution Attenuation Option for the PNGI, the available range is 0 to 127.9dB in steps of 0.1dB attenuation. Maximum signal power is output when the attenuator is programmed for 0.0dB. As the attenuation level is increased, the output signal component decreases. To program or view the attenuation of the Noise Source, key-in FUNCT 1. The current value of the attenuation level will be displayed in numeric digits and the F1 indicator will be lit. To alter the current value, either:

1. Key-in the new value desired (up to the maximum) followed by ENTER. The digits will fill the display from right to left, with the right-most position representing 0.1dB.

OR

2. Press the Increment (I) or Decrement (D) key. The "Inc" or "Dec" message will show in the display, and the step value (described below) will be combined with the previous attenuation value when the command is ENTERed.

The new value will not replace the old unless ENTER is keyed. Regardless of the value displayed, the true decimal fraction will be ZERO unless the high resolution option has been installed.

STEP SIZE: F2 d1 d2 d3 d4

Step value for the above mentioned Increment (I) and Decrement (D) functions is also programmable through the keypad. To view the currently programmed step size for the noise signal attenuator, Key-in FUNCT 2. The value will be displayed and the F2 indicator will be lit. This value will be added to or subtracted from the current value each time the Inc/Dec key is pressed when in the F1 attenuator programming mode. To alter the step value, key in the desired new value followed by ENTER. The digits will be displayed as entered, but will not take effect until the ENTER key is pressed.

FILTERING: F3 dl

Filtering of the noise signal is controlled by function F3. There is an array of up to 7 filtering elements and a dummy load within the PNGI which are used to control the signal's bandwidth. The programmer can select any of the 8 positions through the keypad, up to 4 simultaneously. Filter position 1 (one) is used to connect full frequency band to the circuit. Filter position 2 (two) is used to disconnect the signal from the other processing stages by directing it to a dummy load. The specific bandwidths provided by the six other selections are tabulated in the Appendix. To view the current filter position, key-in FUNCT 3. The display will show the position Number (1:8) and the F3 indicator will be lit. To alter the position number, key-in the new value (1:8) followed by ENTER.

If, at any time during the key-in of an attenuation level, step size, or filter position, an incorrect value is typed before pressing ENTER, the CLEAR button can be used to erase the command entered thus far. Re-key the correct values and press ENTER.

If a data entry mistake is detected after the ENTER key is pressed, simply re-key the entire sequence beginning with the FUNCT key. Note: all or part of the erroneous command may have been executed before the correction is made.

Programming the attenuation, step size and filtering functions for the user supplied component of the composite output is accomplied in an identical fashion as was described for the internal noise source. The respective function codes are F5, F6 and F7.

REMOTE I/O: F4 d1 d2 d3 d4

Function F4 is used to program the PNGI to accept commands from a host computer, terminal, or automated test equipment (ATE). To view the currently programmed parameter, key-in FUNCT 4. The data will be displayed and the F4 indicator will be illuminated.

F4 values in the range 0 through 30 represent the address to which the PNGI will respond when addressed as a listener on the GPIB. Values of 300, 1200 and 9600 represent baud-rates to be used when accessing the PNGI through any of the optional RS-232/422/423 serial interface ports. In this mode, data format is asynchronous ASCII with 8 data bits, no parity, and 1 or 2 stop bits.

To alter the displayed F4 value, key-in a valid address or baud rate followed by ENTER. This new value will be placed into permanent non volatile memory and will remain there until altered, even though unit power may be interrupted.

TIME DELAY: F8 d1 d2 d3 d4

This function provides a time delay, during which previously defined sequence will remain active, before a subsequent takes effect. The duration of the delay can be programmed from 0.1 to 999.9 seconds with resolution of 0.1 second. This feature is conveniently used within a programmed sequence (described below):

SEQUENCES: PROG n1.....ENTER

Up to 4 programmed sequences of multiple functions can be stored in the PNGI's protected memory for later execution. To store such a sequence, key-in PROG followed by the selected number (1-4) of the sequence you wish to store. Follow the sequence number by the one or more functions to be executed sequentially, and terminate the group with ENTER. For example, to program sequence #1:

PROG1 F110.0 F21.5 F36 F82.5 F30 F8.5 F1I Enter

1 Would set attenuation of the noise source..10.0 dB
2 Noise attenuation step size.....1.5 dB
3 Noise filter number.....6
4 Sustain the above conditions for.....2.5 sec
5 Disconnect noise from output - Noise Filter #0
6 Sustain the disconnect for..... 0.5 sec
7 Increment the noise attenuator by step size and repeat from line 4 above until the maximum attenuation is reached, then would start again from line 1. This programmed function would continue, once triggered, until interrupted by a key-press or remote command.

Another example, programming sequence #4:

PROG4 F10 F210 F31 F51270 F610 F77 F81 F1IF5V ENTER

1 Would set Attenuation of the noise source...0 dB
2 Noise Attenuation Step Size.....1 dB
3 Noise Filter Number.....1
4 External input attenuator.....127 dB
5 External attenuator step size.....1 dB
6 External filter number.....7
7 Sustain the above conditions for.....1 sec
8 Increment the noise attenuation by step.....1 dB
9 Decrement the external input atten. by step.1 dB
and repeat from line 7 and continue until interrupted

Note that when values were entered for the attenuators (F1 and F5) and the step sizes (F2 and F6) a least-significant digit of "0" (ZERO) was appended to the values to compensate for the fractional entry position.

As a guide to determining whether a function line will loop continually, or terminate at the end of the string leaving the PNGI set to the most recently programmed values, recognize that the string will only repeat if it contains BOTH an initial attenuation level setting AND a subsequent attenuation increment or decrement command.

example: .....F1102.5.....ENTER
AND
.....F1I.....ENTER
will not repeat, but
....F1102.5.....F1I.....ENTER
WILL REPEAT

to recall and execute any one of the 4 programmed sequences, key-in:

PROG nl ENTER

without any functions specified between the sequence number and the ENTER key.

4-3 REMOTE OPERATION

REMOTE CONTROL OF THE PROGRAMMABLE NOISE GENERATOR

All of the PNGI functions programmable via the front panel keypad (with the exception of F4) may also be controlled through a remote computer, terminal, or automatic test equipment (ATE) using the GPIB or asynchronous interface option ports.

The formats for all commands are identical to the previously described keypad sequences, except that the PROGM, FUNCT, CLEAR, INC, DEC, and ENTER keys should be abbreviated by the capital ASCII characters, P, F, C, I, D, and CR (carriage return) respectively. space characters may be inserted for clarity of reading, or may be deleted to improve message throughout. When using the GPIB interface, the message may be terminated by a CR, by the EOI hardware handshake line, or both.

The PNGI, when powered on, is always ready to accept commands and data from a controlling device and respond with acceptance handshaking when required.

TRIGGERING: T d1 [d2 d3 d4 d5]

When operating the PNGI under control of a remote device, an execution trigger may be specified that will cause immediate (default) or deferred execution of the command. The values for d1 and their corresponding effects are tabulated below:

d1 = 0 := Execute immediately on CR (default)
d1 = 1 := Execute upon receipt of a GET code

The T0 or T1 code must be the first command of a multi-byte sequence, and may be optionally followed by 1 to 4 digits representing an initial time delay after which the rest of the command sequence is to be run. For example:

T1 5.5 P1 CR

would wait for a GET (group execute trigger) code as a trigger. It would then delay 5.5 seconds, after which it would recall and execute previously stored program sequence #1.
Alternately, the above command sequence could have been issued as:

T1 5.5 F110 F21.5 F36 F82.5 F30 F8.5 F1I CR

While any of the PNGI functions are activated as a result of a remote command sequence, the corresponding front panel function indicator will blink at an approximately 2 cycles per second. Additionally, the display will flash if a remotely entered command sequence is still executing. This will alert users not to tamper with the front panel keys, as the PNGI may be under a current control sequence from an external device. Pressing a front panel key will interrupt any sequence in progress and seize control of the device unless the GPIB LOCAL LOCKOUT COMMAND (LLC) is issued.

SUMMARY OF PROGRAMMABLE FUNCTION CODES

F1 n1 n2 n3 n4	Noise attenuation level (Max:127.0/127.9*)
F2 d1 d2 d3 d4	Noise attenuation step size (Min:1.0/0.1*)
F3 d1	Noise filter select (range 1:6)
F4 d1 d2 d3 d4	Remote GPIB address/baud rate select
F5 d1 d2 d3 d4	External input attenuator level (Max:127/127.9*)
F6 d1 d2 d3 d4	External input attenuator step size (Min:1.0/0.1*)
F7 d1	External input filter select (Range:1:6)
F8 d1 d2 d3 d4	Time delay functions (Range:0.1:999.9 sec)
P1 through P4	Program/recall operational sequence
F78	Connects second output (#2)
Q, MTA	Remote indicator data transmission
T d1 n1 n2 n3 n4	Remote triggering mode and time delay

*Note: Requires High-Resolution Hardware Option

ADVANCED PROGRAMMING TECHNIQUES

The working buffers in read/write memory occupy two consecutive areas of 32 character capacity each (for the remote command input and the keypad command) followed by a free space of approximately 8 characters capacity. If the PNGI is to be used exclusively under remote control, the command buffer for remote input can occupy up to 72 characters (32+32+8). If remote control is not utilized, or if the amount of the command buffer used for remote commands does not exceed 32 characters, then the keypad command buffer can occupy up to 40 characters (32+8). If there is any doubt about the command buffer boundaries when both local and remote commands are being issued to the PNGI, command strings should be restricted to 32 characters per buffer. A violation of the 72nd character upper limit will cause a BUFFER ERROR MESSAGE to be displayed, and the buffer pointer to be reset to the starting position.

The 4 programmable buffers in protected memory occupy 3 contiguous areas of 32 character capacity and 1 area of 31 character capacity. If a command string has been created in the local or remote command buffer which exceeds the 32 character limit, it may be stored and recalled from the 4 protected memory buffers but the programmer must recognize that Buffer #4 has a maximum capacity of 31 characters. Buffer #3 has a capacity of 63, if allowed to spill into Buffer #4 space. Buffer #2 has a capacity in excess of 80 characters if allowed to use space for #3 and #4 as well, as does Buffer #1 which can flow into the others. Exceeding the upper limit will cause a BUFFER ERROR.

It is possible to daisy-chain command sequences to increase the effective length of command sequences. For example, consider this sequence:

COMMAND STRING	RESULT
P1...function sequence...P2 CR	Save sequence in buffer #1
P2...another sequence...P3 CR	Save sequence in buffer #2
P3...another sequence...P4 CR	Save sequence in buffer #3
P4...final sequence.....CR	Save sequence in buffer #4
P1 CR	Load buffer #1 into working Buffer & Execute. Then chain to next buffer in sequence. Execute & chain. Execute & chain.

Or consider programming the 4th entry above as:

P4...Loop back sequence...P1 CR	Performance as above, but return to Buff #1 upon completion of #4.

Or consider programming the 4th entry as:

P4...F10.....F1I.....CR	At the end of seq. #4, looping function will be recognized & seq. #4 will repeat until interrupted.

IMMEDIATE MODE NOISE ATTENUATION PROGRAMMING

If the first keystroke entered after power-on or since the last ENTER key press is "I" or "D" then that front-panel keystroke is interpreted as either "F1 I ENTER" or "F1 D ENTER" and is executed immediately, causing the F1 Function LED to be illuminated and the current noise attenuation level to be adjusted by the step value and displayed. This feature is only operable from the front-panel keypad.

The following error messages may appear on the PNGI display:

Err.	Key stroke error.
Err.B	Buffer - too many characters. Reset.
Err.P	Program mode error - improper sequence.

4-4 REMOTE INDICATORS (IEEE488 BUS ONLY)

The controller may ask the programmable noise generating instrument to send remote indicator data as follows:

1. The controller should write a command string which includes the letter Q.

2. At any time after sending Q, sending MTA will cause the Instrument to send a remote indicator data string.

3. Remote indicator data will include the following string of digits separated by comma.

4 digits, noise attenuator (no decimal point) the least significant digit is the decimal digit.

4 digits, noise attenuator step size.

4 digits, noise filter switch positions actuated (position 1 noise ON, position 2 noise OFF)

4 digits, GPIB address

4 digits, input attenuator (no decimal point) the least significant digit is the decimal digit.

4 digits, input attenuator step size

4 digits, input filter switch positions actuated (position 1 noise ON, Position 2 signal OFF)

4 digits, time delay function

0,1 local lockout by controller. 1 indicating local lockout.

This data string will be followed by <CR> and <LF>

Q must be sent prior to each MTA request. The full data string will be sent after each request.

4. Power on/off. No response from noise generating instrument if power off.

NOTE: If the time delay function is activted, the controller will get no response. The instrument will again respond to inquiry when the time delay is complete.

V. PERFORMANCE VERIFICATION

5-1 TEST EQUIPMENT

Spectrum Analyzer, Hewlett Packard 853A, 8557A, 8558B.

Dynamic Signal Analyzer (FFT) Hewlett Packard 3561A.

Power Meter, Hewlett Packard 432A.

RF Voltmeter Hewlett Packard 3400A.
(True RMS Voltmeter)

Digital Plotter Hewlett Packard 7470A.

Temperature Compensated Thermistor Mount
Hewlett Packard 478A or 8478B.

Attenuator, Weinschel Engineering 4M-10dB.

Computer, Hewlett Packard Model 85B.

5-2 FREQUENCY RESPONSE

Frequency response may be verified by placing a 10dB attenuator on the output of the programmable noise instrument and viewing on a spectrum analyzer of FFT as appropriate.

5-3 POWER OUTPUT

Power output may be measured by means of a power meter and thermistor mount for frequencies above 10MHz. Below 10MHz, a true RMS voltmeter such as HP3400A with 50 ohms shunting the input, should be used.

5-4 DIGITAL FUNCTIONS

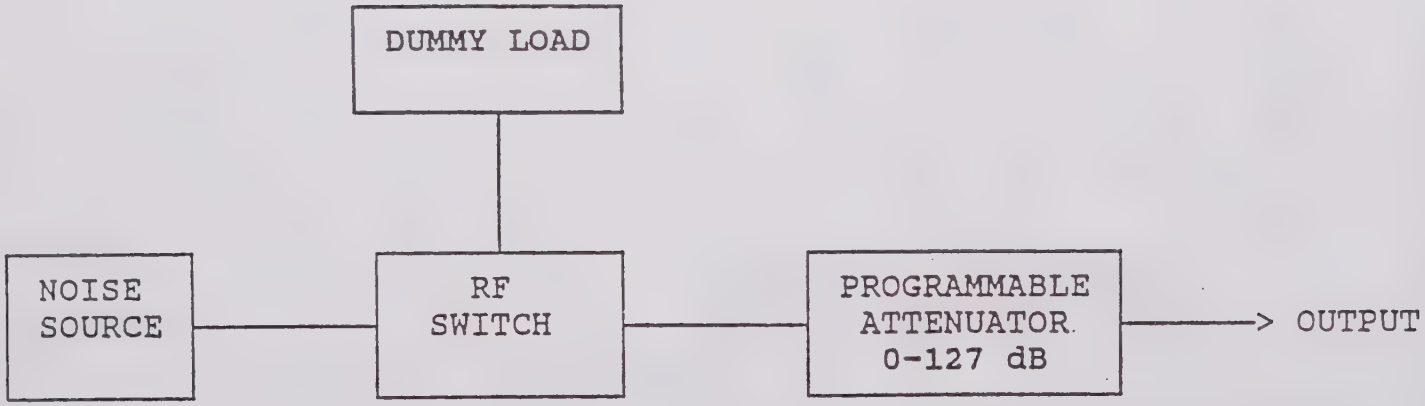
Digital functions may be verified by means of the programming instructions of section 4-3.

VI. ADJUSTMENT AND CALIBRATION

The programmable noise generating instrument should be returned to Noise Com, Inc. for adjustment and calibration.

VII. SERVICE

The programmable noise generating instrument should be returned to Noise Com, Inc. for service. Power schematic is shown in Figure #4.



BASIC RF CIRCUIT
FIGURE:1

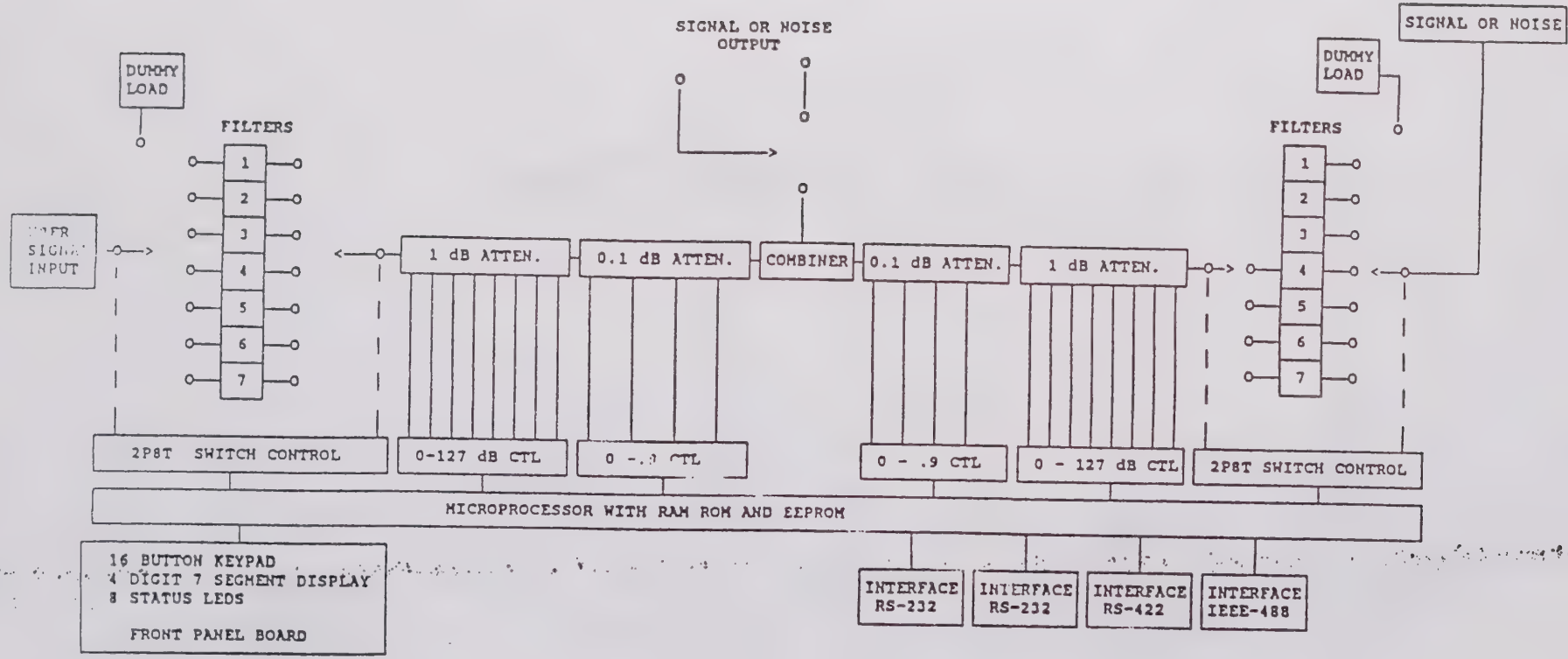

SIGNAL OR NOISE OUTPUT
DUMMY LOAD
FILTERS
1
2
3
4
5
6
7
SIGNAL OR NOISE
DUMMY LOAD
FILTERS
1 dB ATTEN.
0.1 dB ATTEN.
COMBINER
0.1 dB ATTEN.
1 dB ATTEN.
2P8T SWITCH CONTROL
0-127 dB CTL
0 - .9 CTL
0 - .9 CTL
0 - 127 dB CTL
2P8T SWITCH CONTROL
MICROPROCESSOR WITH RAM ROM AND EEPROM
16 BUTTON KEYPAD
4 DIGIT 7 SEGMENT DISPLAY
8 STATUS LEDS
FRONT PANEL BOARD
INTERFACE RS-232
INTERFACE RS-232
INTERFACE RS-422
INTERFACE IEEE-488

FIGURE 2

PROGRAMMABLE NOISE GENERATING INSTRUMENT
FRONT PANEL LAYOUT

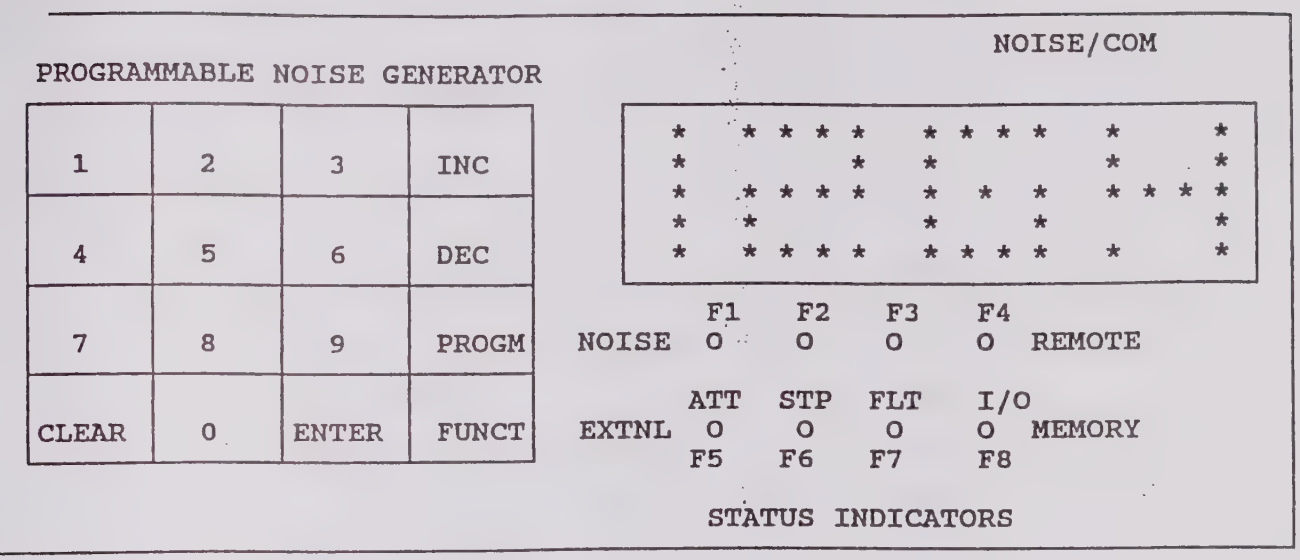


FIGURE 3

7-1 COMMON PARTS

GPIB CONNECTOR	IEEE-488-1
FUSE	1A
FUSE HOLDER	F004-ND
POWER SUPPLY (5 VOLTS)	HB5-3.5
POWER SUPPLY (28 VOLTS)	HB28-1
LINE CORD	17250
DISPLAY BOARD	3.1 A/R
PROGRAMMABLE BOARD	3.1 A/R
SWITCH (ON/OFF)	31-281-025
SWITCH LENS CAP	31-963-9
SWITCH, LAMP	31-963-1
LED COVERS	4341
RESET SWITCH	19-159-015
RESET LENS	19-159-8
CABINET	R517-12
LOAD	T185M

7-2 PARTS LIST

NOISE SOURCE	NC7109A
PROGRAMMABLE ATTENUATOR (1dB/STEP)	50P-331
COAXIAL SWITCH	2S2B-11
AC RECEPTACLE / EMI FILTER	3EF2F
OUTPUT CONNECTOR	SMA (F)

TEST EQUIPMENT FOR WIRELESS & TELECOMMUNICATIONS...

Precision C/N Generators	Page 4
JitterBERTs	7
BER Testers	8
Multipath Fading Emulators	10
E/S and Cell Site Monitors	12
Noise Figure Instruments	14
Amplifier NPR Test Stations	16
VXI Modules	18

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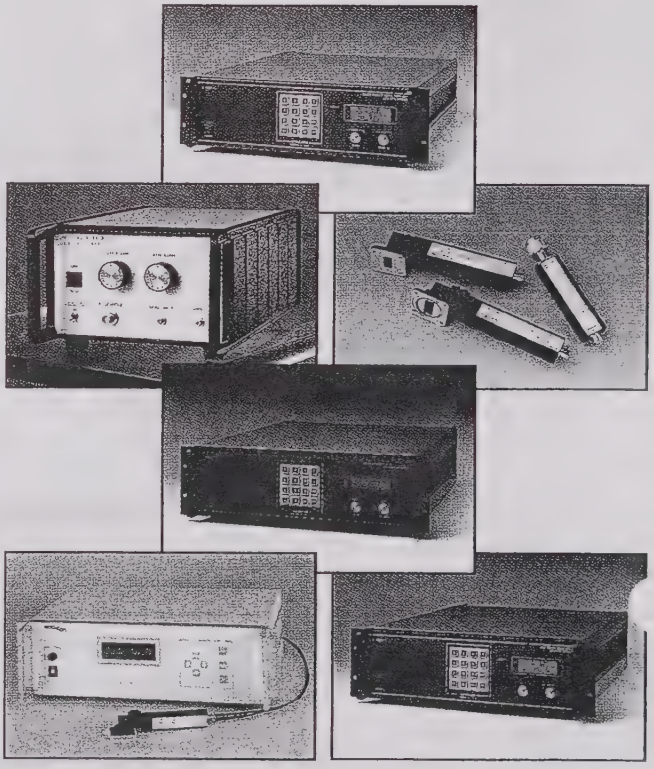
Noise Com Meets the Tough Challenges Head On...

Attention to customer needs has been the cornerstone of Noise Com since we formed the company in 1985. So whether you need help with a new application or have a technical question, Noise Com is here to help. Your request will be handled by someone with a working knowledge of our products and their applications who understands the urgency of your needs.

Noise Com has established a solid reputation for quality, performance, and product support that is among the most highly regarded in the industry. We fully stand behind our products, and we'll always be there to help. Our design, manufacturing, and control practices have been finely honed after years of manufacturing products for the military, and we put that same level of workmanship into all of the instruments in this catalog.



About Noise Com

Noise Com is a public company (AMEX, NOI), and is headquartered in a 12,000 ft.^{2} facility in Paramus, NJ. We have assembled a group of dedicated, knowledgeable, creative people who have a wide range of backgrounds, from military systems to telecommunications, components, test and measurement, and software development.

Noise Com has a wide variety of capabilities, including a 150 sq. ft. Class 10,000 clean room for hybrid and MIL-STD-883 microelectronics assemblies, computer-aided mechanical design and PC board layout system supplemented by circuit simulation and software emulation capabilities, MIL-I-45208 inspection system (ISO-9000 certification is anticipated in the near future), and enviromental screening and testing of MIL-STD-883 and MIL-STD-202, including temperature cycling, thermal and mechanical shock, random and sinusoidal vibration, and gross and fine leak tests.

In addition, Noise Com has in-house certified instructors, inspectors, and assemblers for the MIL-STD-2000 workmanship standard, and maintains ESD protection to MIL-STD-1686 and MIL-HDBK-263. The company's EMI shielded MIL-C-45662 calibration department has standards traceable to NIST.

In addition to the instruments shown in this catalog, Noise Com manufactures a complete line of noise sources (see page 19). We have grown over the last eight years to become the largest supplier of noise sources in the US, and one of the most recognized names in noise technology throughout the world.

If You Don't See It, Ask For It...

Designing custom products is a fundamental part of our business, and we specialize in taking a concept and making it a reality in a remarkably short time. So if you don't see exactly what you're looking for in this catalog, simply call a Noise Com representative at (201) 261-8797 or send us a fax at (201) 261-8339.

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Why Noise-Based Test Equipment?

Modern communication systems are required to perform almost flawlessly in an environment where interference, electrical noise and frequency crowding make the task more and more difficult. These problems are all forms of "noise" and must be overcome in the development stage and monitored during operation in the field. Noise Com's noise-based test equipment is the fastest and most accurate way to solve your noise problems in the laboratory and in the field. In this catalog you will find a comprehensive line of noise-based test equipment to simulate the real world and help you win the battle.

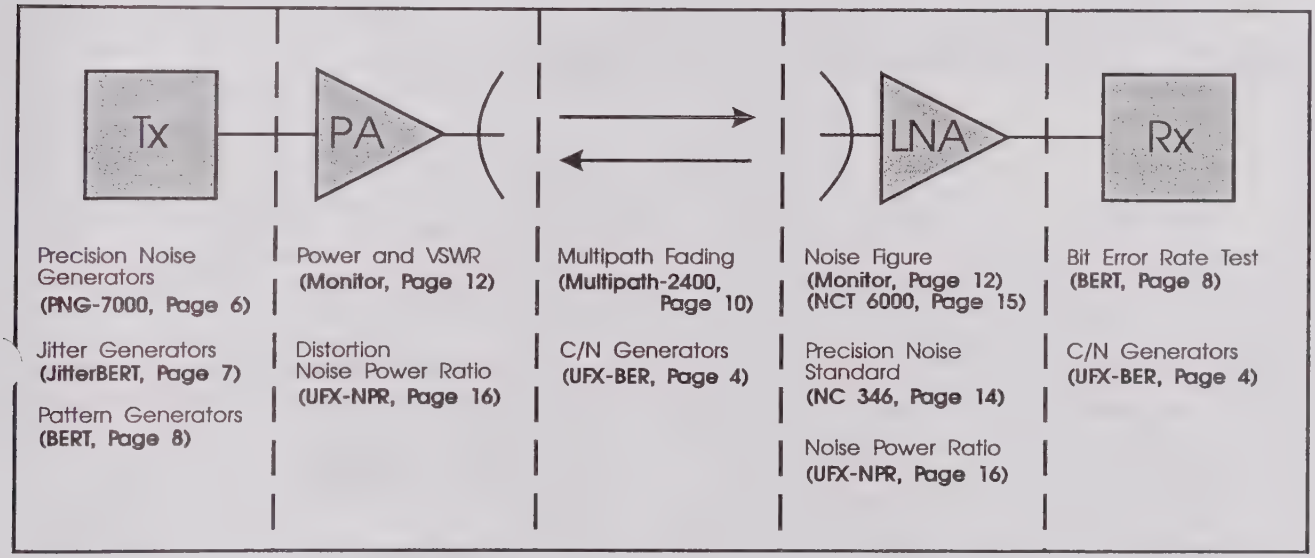
Noise Com, Inc., manufactures a complete range of equipment for wireless and telecommunication performance testing. This test equipment fulfils the need for emulation of a communication channel from antenna to antenna or from transmitter to receiver.

Such emulations consist of signal-to-noise or bit-energy-to-noise-density (E_b/N_o) ratios, injection of interference, multipath fading, data and clock jitter, amplifier noise power ratio (intermodulation) tests, noise figure (sensitivity) measurements, plus noise figure, gain, VSWR, and power monitoring.

Noise Com's comprehensive range of test equipment is targeted at the evaluation of modern digital communication systems employing TDMA, CDMA, FDM, burst, frequency hopping, and advanced coding techniques.

The equipment has been listed on several recommended test equipment lists and it is designed to perform tests to several international specifications. Some of these specifications include: DCS-1800, GSM, Iridium, Inmarsat, Intelsat, Milstar, NASA TDRSS, IS-54, IS-95, SONET, and CCITT G.826.

No matter which part of the system you are involved with, Noise Com has an instrument to help you.


Tx
PA
LNA
Rx
Precision Noise Generators (PNG-7000, Page 6)
Jitter Generators (JitterBERT, Page 7)
Pattern Generators (BERT, Page 8)
Power and VSWR (Monitor, Page 12)
Distortion Noise Power Ratio (UFX-NPR, Page 16)
Multipath Fading (Multipath-2400, Page 10)
C/N Generators (UFX-BER, Page 4)
Noise Figure (Monitor, Page 12) (NCT 6000, Page 15)
Precision Noise Standard (NC 346, Page 14)
Noise Power Ratio (UFX-NPR, Page 16)
Bit Error Rate Test (BERT, Page 8)
C/N Generators (UFX-BER, Page 4)

- The **Monitor** system makes on-line performance monitoring of transmitter power, antenna VSWR and receiver noise figure simple.
- The **Multipath** emulates multipath Rayleigh, Rician, and log normal fadings in the laboratory or in the field.
- The **NCT-6000** turns a spectrum analyzer into a high resolution noise figure meter.
- The **UFX-BER** sets and maintains a calibrated E_b/N_o or C/N ratio between a user provided carrier and internally generated noise. The UFX-BER also allows setting of accurate carrier-to-interference ratios.
- The **UFX-NPR** performs automatic intermodulation and noise floor test using the noise power ratio method. This method accurately emulates the loading of FDM and CDMA base stations, telephone networks, and satellite communication amplifiers with multiple carriers.
- The **PNG-7000** is a precision noise generator with a high crest factor and a low distortion summing input to perform signal-to-noise ratio testing at baseband, IF and RF frequencies.
- The **JitterBERT** combines a BER pattern generator with a jitter generator and a BER tester.

Noise Com also has a full line of general purpose noise generators and software support for ATE applications, such as the software drivers listed in the National Instruments LabWindows Library and the VXIbus noise modules.

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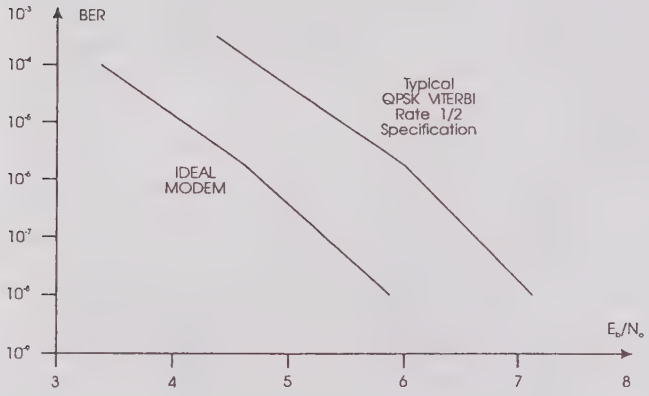
Noise and Bit Error Rate Testing

Bit Error Rate (BER) is the predominant parameter for determining the performance of a communication link. Bit error rate increases as the signal-to-noise ratio decreases due to the uncertainty imposed on the decision making circuitry by the noise. Understanding the nature of noise and how it affects the transmission link is critical to designing an effective system.

BER VS. E_b/N_o CURVE

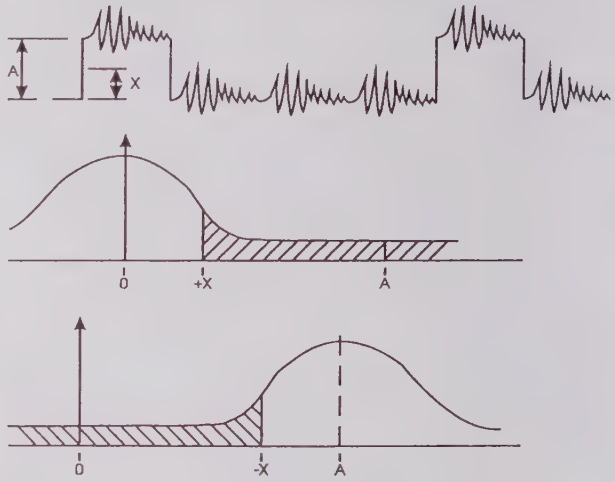


The ratio of the signal amplitude and the noise amplitude can be expressed in many different ways. Sometimes the manner of expressing it is dictated by the system type, sometimes by the test method, and sometimes for convenience. A common form is E_b/N_o, Bit Energy to Noise Density. This form relates the power attributable to a single bit in a 1 Hz bandwidth, and the associated noise power in that 1 Hz bandwidth. The bit energy is found by dividing the total RF carrier power by the data rate. This simple calculation excludes any overhead for forward error correction.

Another form is Carrier to Noise (C/N) ratio which is more suitable for analog type transmissions. In this case, the total carrier power is compared to the total noise power present in the receiver detection bandwidth. A third variation is Carrier to Noise Density (C/N_o).

When testing BER, known noise levels are injected into the system and the resulting BER is measured. The noise can be injected at several points in the system, either baseband, at an IF frequency, or at the RF transmission frequency. In each case, the quality of the injected noise is very important if it is to adequately simulate actual operating conditions. The figure below shows the voltage distribution of a Gaussian noise source, and the effect that noise has on the data stream. If the noise generator has a low crest factor, the voltage excursions beyond ± x will not exist. This will limit the noise peaks imposed on the data stream and therefore will not provide an accurate BER measurement. This is particularly evident when a large C/N ratio is being measured, or if very low bit error rates are being measured. A noise source with a 17 dB crest factor is adequate for measuring bit error rates as low as 10^{-9}.

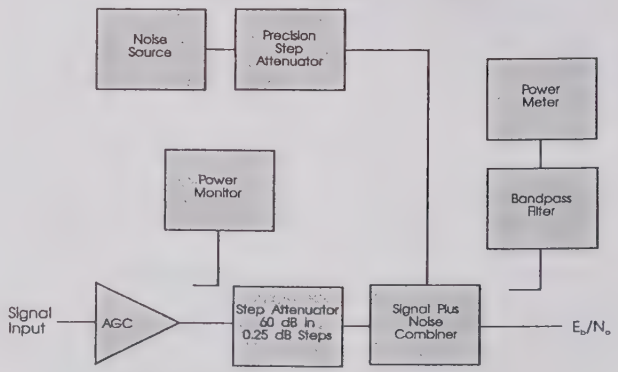
NON-GAUSSIAN NOISE DISTRIBUTION AND ITS EFFECT ON BER TESTING



Some of today's sophisticated systems must have a BER performance of 10^{-12}. Actual measurement time for these rates can be days. This is impractical for production testing. By using noise injection, the performance of the system can be measured at higher bit error rates in a matter of minutes.

The UFX-BER is a fully automated instrument which sets C/N ratios over a wide range of signal power and frequency ranges.

BLOCK DIAGRAM OF THE UFX-BER SERIES INSTRUMENT



An internal precision noise source with a high crest factor is summed with the user-supplied signal. A power meter measures the signal and the noise and then the instrument sets the desired ratio to within ±0.21 dB RSS. Special configurations are available which allow worst case accuracies of ±0.05 dB. The instrument automatically compensates for bit rates, receiver bandwidth, noise floor contributions, etc. to provide a measurement as simple as pressing one button.

For noise injection at baseband and for test stations not requiring the automation simplicity of the UFX-BER, the PNG-7000 Series precision noise generators are ideal. They generate high-quality noise suitable for BER testing and an internal summing junction is provided with a low distortion signal path. The PNG-7000 may optionally be configured to be DC coupled for noise injection at baseband.

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Precision C/N and E_b/N_o Generators

UFX-BER Series

General Specifications

Carrier Path

Attenuation	0 to 60 dB, automatically programmed
Range of carrier input power (C_{in})	-55 to +5 dBm
Flatness	±0.20 dB for 70 MHz ±20 MHz ±0.30 dB for 140 MHz ±40 MHz
Group delay	0.20 ns or less

Output Path

Range of carrier output power	-55 dBm to carrier input level or +3 dBm, which ever is lower *
Range of noise output power (N)	-55 dBm to +3 dBm*
Noise flatness	±0.50 dB or less from 100 kHz to 200 MHz
Accuracy of C/N	See graph
Third-order intercept point	+29 dBm typical
Crest factor (peak to average noise voltage)	18 dB at output levels up to 0 dBm

* Please consult factory for specifics.

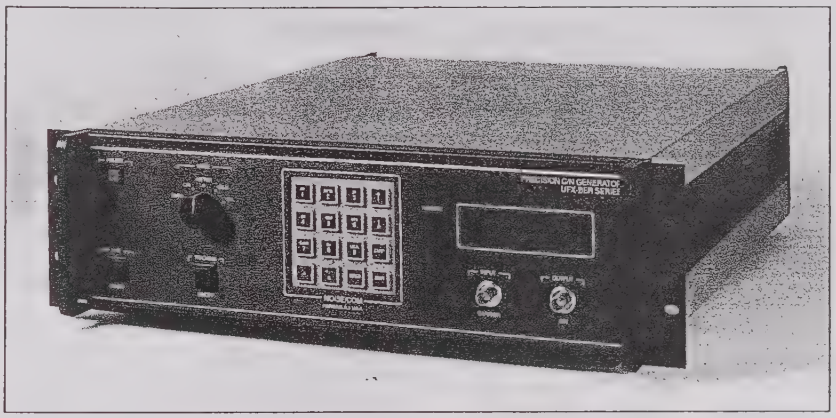
Applications:

- Satellite, wireless and telecommunications systems

Features:

- Direct display of E_b/N_o, C/N, C/N_o or C/I
- Accuracy of 0.21 dB RSS
- Bit rate entry, 1 bit/s to 500 Mbit/s
- Variable output power

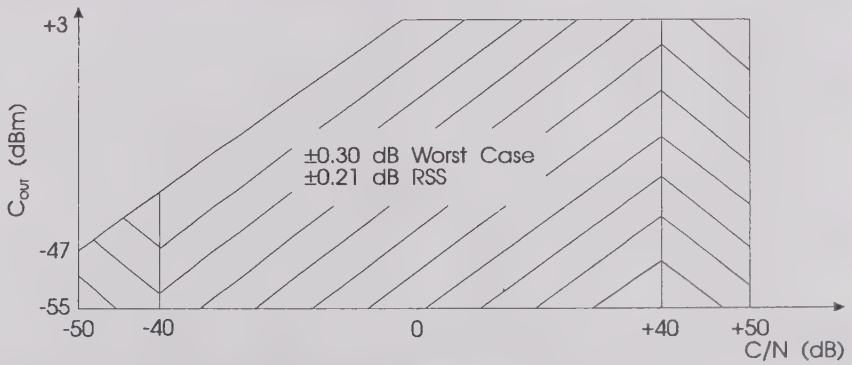
The UFX-BER Series sets an accurate E_b/N_o or C/N ratio between a user-provided signal and internally-generated noise. The UFX-BER generates E_b/N_o for IF back-to-back or loop-back testing with extreme precision over a broad range of input or output power, steps, increments, and decrements. E_b/N_o values can be entered directly in dB from the front panel or by IEEE-488 bus. The instrument is equipped with an interferer input for C/I tests. The instrument measures 5 1/4 in. high, 17 in. wide, and 21.5 in. deep and comes with brackets for 19-in. rack mounting.



Typical Frequency Ranges for the UFX-BER Series

Model	Frequency Range	Application
UFX-BER-.455	0.455 MHz +/-7.5 kHz	General purpose
UFX-BER-10	10.7 MHz +/-7.5 kHz	General purpose
UFX-BER-21	21.4 MHz +/-7.5 kHz	General purpose
UFX-BER-45	45 MHz +/-7.5 kHz	General purpose
UFX-BER-70	50 to 90 MHz (or 68 to 72 MHz)	General purpose
UFX-BER-IF1	50 to 90 MHz and 100 to 180 MHz	Intelsat
UFX-BER-370	350 to 390 MHz	NASA TDRSS
UFX-BER-750/300	650 to 850 MHz and 250 to 350 MHz	Irridium
UFX-BER-800	700 to 900 MHz	Milstar
UFX-BER-836	824 to 849 MHz	IS-95, dual-mode, CDMA
UFX-BER-915	902 to 928 MHz	Part 15, spread spectrum
UFX-BER-1200	950 to 1210 MHz and 1190 to 1450 MHz	L-band modems
UFX-BER-1545	1530 to 1560 MHz	Inmarsat
UFX-BER-1850	1800 to 1900 MHz	DECT, DCS-1800
UFX-BER-1912	1895 to 1930 MHZ	PHP, Japan. PCS, USA
UFX-BER-2442	2400 to 2484 MHz	Spread spectrum

Please consult the factory for other frequency ranges. Up to six frequency ranges or bandwidths may optionally be installed in one instrument.



C/N Accuracy Versus Carrier Input Level at 23°C±3°

Options:

1. Automatic gain control amplifier to maintain constant carrier power level
2. Other custom configurations
3. 50-ohm input and output impedance instead of standard 75-ohm impedance
4. RS-232C, RS-422, or RS-423 interface in addition to IEEE-488 interface
5. 230 VAC, 50 Hz, instead of standard 110 VAC, 60 Hz

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Precision Noise Generators (AWGN)

PNG-7000 Series
10 Hz - 1.5 GHz

General Specifications:

Output	White Gaussian noise
Crest Factor	18 dB minimum
Output Noise Power	+3 dBm
Noise Attenuator Range	0 to 63 dB in 0.25 dB steps
Noise Attenuator Accuracy	±0.2 dB
Signal Path Gain	0 ±1 dB
Group Delay Variation	±0.2 ns/40 MHz
Signal Path Flatness	±0.1 dB/40 MHz
Standard Connectors	BNC female
Dimensions	432 mm W x 133 mm H x 318 mm D (17 in. W x 5.25 in. H x 12.5 in. D)
Mounting	Front panel handles and fold-down feet for bench mounting Brackets included for 19 in. rack mounting
Power	115 VAC , 60 Hz (230 VAC, 50 Hz optional)
Operating temperature	-10° to +60°C

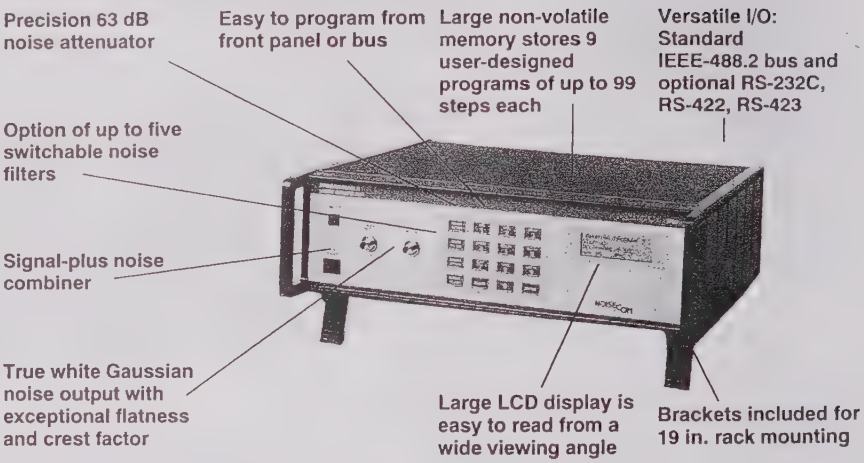
Applications:

Testing of:

- Digital line systems based on cable and fiber optics (CCITT G.951 and SONET)
- Data regenerators and multiplexers

Features:

- Noise Injection at baseband, IF and RF
- Internal summation of signal and noise
- Displays noise power in dBm
- Crest factor of 18 dB minimum
- Group delay variation less than 0.2 ns/40 MHz
- Nominal loss in signal path is 0 dB
- AC coupled signal path is standard
- DC coupled signal path (optional)


Precision 63 dB noise attenuator
Easy to program from front panel or bus
Large non-volatile memory stores 9 user-designed programs of up to 99 steps each
Versatile I/O: Standard IEEE-488.2 bus and optional RS-232C, RS-422, RS-423
Option of up to five switchable noise filters
Signal-plus noise combiner
True white Gaussian noise output with exceptional flatness and crest factor
Large LCD display is easy to read from a wide viewing angle
Brackets included for 19 in. rack mounting

The PNG-7000 Series instruments generate additive white Gaussian noise and provide a summing input to perform signal to noise or carrier to noise ratio testing capability. A key feature of this instrument is its low distortion signal path which sums the user-supplied signal with the internal precision white noise source. The signal path has a nominal insertion gain of 0 dB, with very low amplitude and phase ripple. The noise source provides an exceptionally high crest factor of 18 dB for accurate bit error rate testing even with large Carrier to Noise (CNR), or Bit Energy to Noise Density E_bN_o ratios. With option 7 (DC instead of AC coupled) signal path, the PNG-7000 can add noise directly to a digital TTL, ECL, or similar signal which operates in a 50 ohm system.

The standard PNG-7000 is a broadband device. For applications in which the frequency range is limited, the unit can be configured with up to five band-limited noise sources, each optimized for flatness over the specified frequency band.

The PNG-7000 Series is microprocessor-controlled and continually provides information about operation of the instrument on a 4 x 20 character LCD display. The instruments allow control of the noise level, noise on/off, signal on/off, and noise source selection in three ways: at the front panel keypad, remotely via IEEE-488 bus, or automatically under program control.

The PNG-7000 instruments can be integrated into a test station where under software control (LabWindows drivers are available from National Instruments) and with the aid of a precision power meter, carrier to noise ratios can be set. Once a CNR calibration has been performed, the ratio can be changed using the internal precision attenuator to vary the noise power without degrading accuracy. The output noise power level is factory calibrated at a 0 dB attenuator setting and is displayed in dBm.

Every front panel operation except instrument on/off is programmable, and the user can create up to nine test routines that can run automatically under program control. These routines can include delay times and loops, and can be executed manually or via bus control. The routines are easily written using the program key and information on the display guides the user through the next steps.

Options:

1. SMA female connectors
2. 75 ohm impedance
3. 220 VAC, 50 Hz
4. Switched noise source bank, up to 5 sources
5. RS-232C, RS-422, RS-423, in addition to standard IEEE-488.2 interface
6. Attenuator for the signal path, 127 dB in 1 dB steps.
7. DC coupled signal path with 0 ± 1 dB gain

PNG-7000 SERIES

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS				
		Power	Vrms	dBm/Hz	Flatness (dB)	Crest Factor
PNG-7105	1 MHz — 10 MHz	+3 dBm	0.316	-67	±0.25	18 dB
PNG-7107	10 MHz — 100 MHz	+3 dBm	0.316	-77	±0.25 / 40 MHz	18 dB
PNG-7108	10 MHz — 500 MHz	+3 dBm	0.316	-84	±0.25 / 40 MHz	18 dB
PNG-7109	10 MHz — 1000 MHz	+3 dBm	0.316	-87	±0.25 / 40 MHz	18 dB
PNG-7110	10 MHz — 1500 MHz	+3 dBm	0.316	-89	±0.25 / 40 MHz	18 dB

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JitterBERT

Combines the G.826-BERT with a jitter generator in one enclosure.

Applications:

- Token ring
- IEEE 802.5
- CCITT G.823 & 0.171

Features:

- BER versus jitter
- Programmable amplitude and frequency
- 486DX/33 built in
- High-resolution VGA display

The JitterBERT accepts a digital data or clock signal and adds phase jitter to the signal. The frequency and amplitude of the jitter is programmable to meet international specifications and recommendations.

The combination of the JitterGEN and the G.826-BERT in one enclosure enables the generation of data patterns and clock signals including jitter. Signals can be generated and adjusted to ensure that digital circuitry works properly at specified levels of jitter.

The JitterBERT has been designed to meet IEEE 802.5 and CCITT's Recommendations G.823 and 0.171.

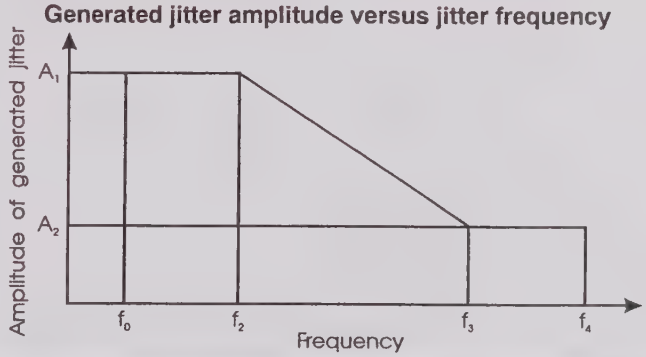
Jitter Generator Specifications

Jitter frequency range	10 Hz to 8 MHz
Frequency resolution	2 Hz
Frequency accuracy	+/-5 ppm
Jitter amplitude	0 to 64 UI peak from 2 Hz to 20 kHz descending linearly to 0.16 UI peak at 2 or 8 MHz, or 0.5 UI peak at 6 to 400 kHz according to the table below
Jitter resolution	0.01 UI
Return loss	20 dB minimum
Connectors	BNC or per CCITT G.703
Input/output amplitude	Recommendation G.703, TTL, CMOS, ECL, PECL in 50 mV steps

BERT Specifications

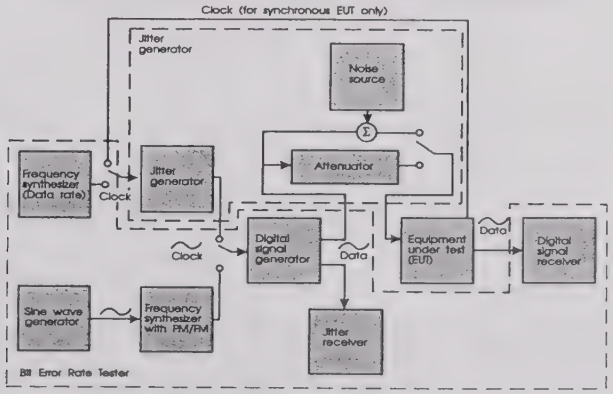
See G.826-BERT, page 8

Generated jitter amplitude versus jitter frequency



BIT RATE (kbit/s)	A_1: MINIMUM VALUE OF GENERATED JITTER FROM f_0 TO f_2	A_2: MINIMUM VALUE OF GENERATED JITTER FROM f_3 TO f_4
64	5.0 UI from 2 Hz to 600 Hz	0.5 UI from 6 kHz to 10 kHz
1544	10.0 UI from 2 Hz to 200 Hz	0.5 UI from 4 kHz to 40 kHz
2048	10.0 UI from 2 Hz to 2400 Hz	0.5 UI from 45 kHz to 100 kHz
6312	10.0 UI from 2 Hz to 1600 Hz	0.5 UI from 32 kHz to 160 kHz
8448	10.0 UI from 2 Hz to 400 Hz	0.5 UI from 8.5 kHz to 400 kHz
8448 (low Q)	10.0 UI from 2 Hz to 10.7 kHz	0.5 UI from 200 kHz to 400 kHz

Block Diagram of the Noise Com JitterBERT



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G.826-BERT

DC to 8.448 Mbit/s (plus 16 MBit/s)

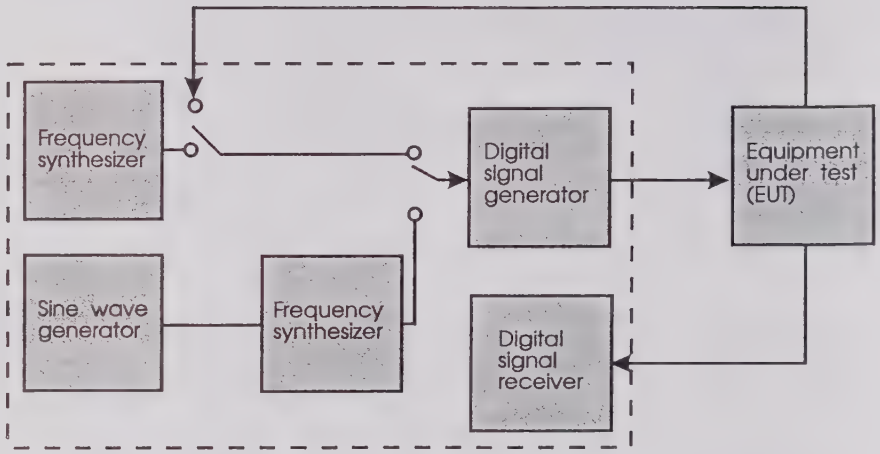
Applications:

- CCITT G.703 & 704
- ISDN
- ANSI
- CDMA, GSM, DCS, DECT
- FDDI
- Token ring
- V.35/306, RS-449, X.21
- Satellite, wireless and telecommunications

Features:

- G.826 or G.821 recording format
- VGA display of histograms and data
- 486DX/33 built-in
- Auto leveling and synchronization
- Propagation delay measurement
- Burst, packet, and TDMA modes

Block diagram of the G.826-BERT



The G.826-BERT bit-error rate tester is designed to meet the enhanced requirements of the new CCITT Recommendation G.826. The G.826-BERT has a built-in 486DX/33 MHz computer including VGA monitor. The computer makes it possible to display, store, and recall the BER analysis in formats for GSM, DCS, DECT, CT-2, PHP, NADC (CDMA), wireless communication testing as well as in the formats for G.703, G.704, G.821 and G.826 telecommunication and FDDI or token ring local area network testing.

The G.826-BERT generates the data patterns and measures the bit-error rate of systems with data rates from DC to 8448 kbit/s (plus 16 Mbit/s for token ring). Pseudo random bit sequences (PRBS) up to 2^{32}-1 are available and these may be mixed with framing and cycle-redundant-check (CRC) bits to generate user specified patterns.

Output amplitudes are programmable in 50 mV steps to meet TTL, ECL, PECL, CMOS and CCITT levels, and the data can be formatted as AMI, HDB3, B6ZS, B8ZS or Manchester encoded. Output impedances of 75 ohms and 120 ohms are provided.

The BER analyzer section of the G.826-BERT automatically synchronizes to the data and clock input format, amplitude, and frequency. Synchronization is obtained by use of peak amplitude detection, a delay line for clock de-skewing, detection of inverted and non-inverted data, and a clock slip circuit for pattern synchronization.

When configured with jitter generation capability, the JitterBERT performs all of the functions of the G.826-BERT with added capability of the data and clock jitter. See the JitterBERT for more details on the jitter generation.

The G.826-BERT is also available configured as the NoiseBERT. This instrument combines the capability of the UFX-BER precision carrier to noise ratio generator with the G.826-BERT. The NoiseBERT provides full BER versus E_b/N_o or C/N measurement capability. Test routines are provided which can automatically perform error analysis as a function of CNR or as a function of time. The information is stored and can be displayed in numerous tabular or graphical forms, such as BER versus E_b/N_o or histograms of errors over time.

All of these instruments have friendly graphical user interfaces with context sensitive help menus. This makes them extremely easy to learn and operate. In addition, the powerful PC-based processor and standard interfaces allow it to act as a controller for peripherals and other equipment in automated test stations. All required software is preloaded and configured in the instrument at the factory. Ample space is available on the hard disk drive for user-generated software and data storage.

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G.826-BERT (Continued)

DC to 8.448 Mbit/s (plus 16 MBit/s)

PATTERN GENERATOR		
Pseudo random bit sequences	2^N-1, N=0 to 32 including CCITT O.151 and O.152	
User programmable patterns	0 to 512 kbit	
Burst, packet, and TDMA	User programmable frame and data	
Data and clock	Outputs Amplitude Termination Code	Differential 0.5 to 2.0 Vpp, 50 mV steps 50 ohms, -2.0 to +1.8 V, 50 mV AMI, HDB3, B6ZS, B8ZS, or Manchester (plus CRC-n framing)
Error entry	Single (manual), random bursts, fixed rate, or external	
BER ANALYZER (Built-in 486DX/33 PC)		
Bit errors Framing (CRC) errors	Bit error rate Synchronization loss detection, FAS and AIS alarms included	Clock slips, Code violations
Averaging and percentages	Date and time records	
G.826 Errored Block (EB) G.826 Severely Disturbed Period (SDP) G.826 SES Ratio (SESR)	G.826 Errored Second (ES) G.826 Background Block Error (BBE) G.826 BBE Ratio (BBER)	G.826 Severely Errored Second (SES) G.826 ES Ratio (ESR) G.826 Available Time
G.821 Degraded Minutes G.821 Errored Seconds	G.821 Severely Errored Seconds	
Data and clock	Inputs Connectors	0.5 to 2.0 Vpp 75 ohms unbalanced BNC female, 120 ohms balanced 4 mm banana jacks per CCITT G.703, and 50 pin connector to X.21, RS-449 and V.35 via test cables
CLOCK		
Codirectional, centralized clock, or contradirectional interface		
Internal clock	Synthesized Resolution Reference Stability	50 Hz to 16 MHz 1 Hz 10 MHz +/-5 ppm +/-5 ppm per year
External clock	Frequency Measurement accuracy	DC to 30 MHz +/-5 ppm (or as external ref.)
External reference input	10 MHz +/-100 ppm max. 0.5 to 2.0 Vpp AC coupled, 50 ohms BNC female	
GENERAL		
Internal processor and peripherals	486DX/33 MHz Built-in VGA display 3 1/2 in. floppy drive IEEE 488.2 interface Parallel/printer port	4 MB RAM AT keyboard interface 40 MB hard drive Mouse port Serial (RS-232)
Power requirements	90-264 VAC, 48-66 Hz, autoranging,	300 VA max.
Operating temperature	0 to 60°C	
Instrument safety	UL-1244, CSA 231, IEC-1010-1	
EMC	EN55011, Group 1, Class A	
Size	455 mm D x 364 mm W x 197 mm H	(17.9 in. D by 14.3 in. W by 7.8 in. H)

Multipath-2400

The Multipath-2400 emulates a wireless communication channel with up to 12 paths between a base station and a mobile station. The unit contains an embedded 486DX/33 microprocessor with PC-compatible interfaces including IEEE 488.2, to provide an easily transportable self-contained instrument. The AT-style keyboard and flat panel display make the Multipath-2400 an extremely powerful tool as a stand-alone instrument or as a controller for an entire test station.

The differential path delay and path attenuation, Doppler, and Rayleigh distribution are individually programmable for each path. They are summed at the instrument output, simulating the summation which occurs at the receiver antenna. This summation of multiple signals with random phase causes random amplitude fluctuations or fading. The maximum rate of fading is exactly the Doppler rate.

Using the Multipath-2400

The user can input information directly to the Multipath-2400 by the built-in keyboard and monitor or by using any standard personal computer with an IEEE-488 interface. The Multipath-2400 contains one channel with 3 paths in the standard configuration. It is easily upgraded to a single channel with 6, 9 or 12 paths or to two independent channels of 3 paths each by use of options 1 or 2.

Channel parameters can be updated at a rate of 100 times per second. The instrument can be used in several modes:

1. **Static Mode**
   Here the user individually sets each path with the desired parameters and that scenario is run continuously. Standard test conditions for GSM, DCS, NADC (CDMA), etc. are factory stored and can be recalled from memory.
2. **Dynamic (Graphic) Mode**
   The user enters the initial and final parameters for a dynamic scenario. For example, a mobile phone starts at rest, then accelerates to 96 km/h (60 mph) over a 5 minute period. The user would input the scenario including the reflecting objects on a graphic display. Software would calculate intermediate states for Doppler, delay and
   attenuation.
3. **Data File Generator**
   The user can generate a data file which dynamically changes all parameters during a scenario. This file is recalled from floppy or hard disk and executed by the system. The file is generated by the user.

System Description

All signal processing is done digitally with 12 bit representation of the data. This provides very consistent and drift free results not achievable using analog implementation.

An RF downconverter provides a baseband signal to a high speed analog-to-digital converter (ADC). The ADC provides 12 bit parallel quadrature outputs which are fanned out to the path hardware. The paths are configured such that they can be paralleled for up to 12 paths.

Each path contains identical hardware which is individually configurable. A MAC (multiply/accumulator) performs the function of the Doppler spreading by mixing the I/Q signal samples with two filtered Gaussian signal sources. The result is then delayed and attenuated digitally before being converted to an analog signal using a D/A converter. The composite signal is upconverted. The final output power can be set between -10 dBm and -100 dBm.

The Doppler generator module contains 24 Gaussian noise sources which have a non-periodic time-constant longer than 24 hours. The noise sources can be correlated in pairs by summing a portion of one source with another. Each noise source is then shaped using a digital FIR filter with a bandwidth equal to the Doppler rate.

User Interface

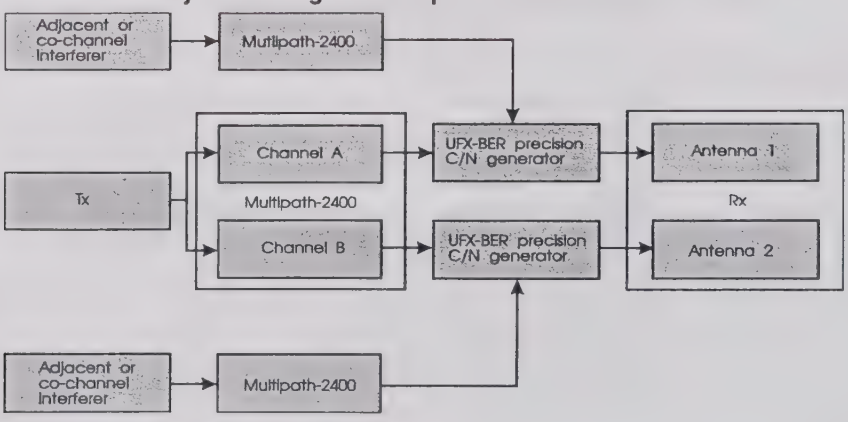
After selection of mode (Static, Dynamic, or User File) the user will supply the following information to run a scenario:

- Center frequency
- Rayleigh (classical), Ricean, or log-normal distribution
- Doppler or vehicle speed
- Doppler spectrum shape
  (see Doppler FIR coefficients below)
- Start and stop time
- Path characteristics
  On/off spectrum Delay
  Attenuation Correlation

This information is entered via the keyboard, the IEEE-488 interface, or a data file. The path settings are displayed on the VGA monitor in a tabular form. The instrument status and graphic representation of certain scenarios, the Doppler spectrum, and the hardware configuration may also be displayed.

Other available features are a help key for setting up path characteristics for desired scenarios, recall/save of setups and data files, plus a data file generator/editor.

Diversity Test using the Multipath-2400 and the UFX-BER



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Multipath-2400 (Continued)

›plications:

GSM
DCS
DECT
PHP (JDCT)
CT-2
NADC (CDMA)
Space diversity tests
Radar target emulator

Features:

- 800 to 2485 MHz
- Rayleigh, Rice and log-normal statistics
- Built-in 486DX/33 MHz PC
- Delay interval to 204 µs with 2 ns resolution
- 12-bit processing for high accuracy

(Continued from page 10)

The user has the capability to tailor the shape of the Doppler spreading by specifying not only the Doppler frequency, but also the power spectral density within the Doppler range, to emulate antenna patterns different from the standard omni-directional model. Up to 15 points can be entered. From these values, the software generates the FIR filter coefficients which best match the desired shape. Generation of the coefficients is done off line prior to running a scenario.

The power spectral points are entered ı tabular form, with the amplitude in dB ɐlative to a reference of 0 dB at the carrier center frequency and the frequency in Hertz as the offset from the center frequency.

Options:

1. Three additional paths. Up to 12 paths can be installed (by the user) in one Multipath-2400 instrument
2. Additional channel. Dual independent channels with three paths each can be factory installed in one Multipath-2400 instrument.
3. Brackets and front plate for 19 in. rack mounting
4. Attenuator for 20 W (+43 dBm) input power
5. Set of interfaces for connection of two channels to accept signals propagating in opposite directions (duplex)

Multipath Fading Emulator	
Frequency range	800 to 2485 MHz*
RF input power range	-10 to +30 dBm*
RF output power	-10 to -100 dBm
Number of paths	3 (up to 12 paths optional in modules of 3 paths each)
RF bandwidth	1.2 MHz at -1 dB points
Insertion gain	0 dB to -130 dB
Amplitude flatness	+/-0.5 dB
Path-to-path amplitude balance	+/-0.1 dB maximum
Path attenuation range	0 to 30 dB
Attenuation resolution	0.25 dB
Attenuation accuracy	+/-0.2 dB
Path on/off ratio	65 dB minimum
S/N ratio at output >-34 dBm	66 dB minimum at 1.2 MHz BW
Spurious output	-60 dBc
Path-to-path delay range	0 to 204.8 µs
Delay resolution	2 ns
Path to path delay accuracy	+/-5 ns maximum
Group delay variation	+/-15 ns typical
Residual channel delay	550 ns maximum
Doppler range	0 to +/-390 Hz (500 km/h at 842 MHz)
Doppler resolution	2 Hz (2 km/h)
Rayleigh distribution	
Repetition interval	24 hours minimum
Deviation from CPDF	+/-0.5 dB maximum
Level crossing rate accuracy	+/-2.5% maximum from ideal
Path-to-path correlation	0 to 100% between any paths
Correlation Resolution	1%
LO input frequency range	RF freq. plus 3200 MHz
LO input level	+10 to +13 dBm
LO feedthrough on RF output	-60 dBm typical
Image feedthrough on RF output	-60 dBc
Internal processor and peripherals	
486DX/33 MHz	4 MB RAM
VGA interface	AT keyboard interface
3 1/2 in. floppy drive	40 MB hard drive
IEEE-488.2 interface	Mouse port
Parallel/printer port	Serial port
RF input/output connectors	50 ohms SMA female
Input VSWR	1.5:1 maximum
Power requirements	90 - 264 VAC autoranging, 48 - 66 Hz, 300 VA maximum
Operating temperature range	0° to 60°C
Instrument safety	UL-1244, CSA 231, IEC-1010-1
EMC	EN55011, Group 1, Class A
Size	455 mm D x 364 mm W x 197 mm H (17.9 in. D by 14.3 in. W by 7.8 in. H)

* Other frequency ranges and power levels are available. Please contact factory for details.

E/S and Cell-site Monitoring Systems

In-Service Monitoring of:

- Transmitter power
- Receiver noise figure
- Antenna VSWR

Applications:

- Earth stations for satellite communication
- Radar systems
- Base stations for cellular wireless communication

Features:

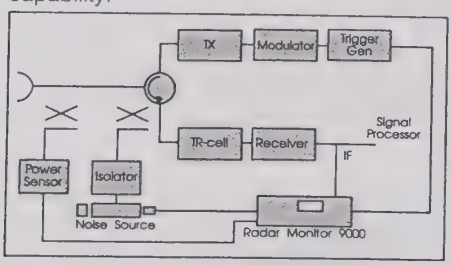
- True RMS power measurements
- Low loss, low VSWR for high power handling
- Up to 4 channels in one monitor
- Adjustable alarm levels
- On-line monitoring with relay alarm contacts
- Trigger input (option) for TDMA, burst and radar applications

The new Monitor Series is designed to monitor the RF performance of a communication or a radar system. Due to its modular design a choice of up to four power measurements and up to four noise figure measurements can be performed simultaneously in one monitor. The instrument is usually equipped to measure the output power, antenna VSWR and receiver noise figure for redundant Tx/Rx systems.

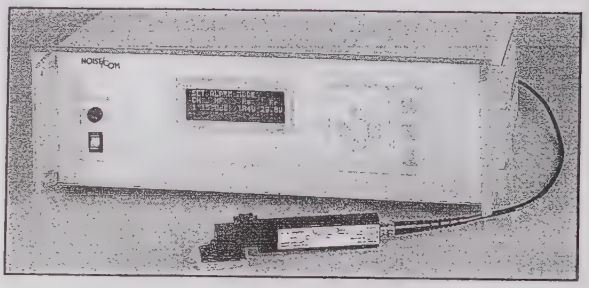
The Monitor Series displays the measured parameters on a 4-by-20-character LCD and compares the measured values with user-set alarm levels. An individual alarm level for each measured value can be set.

The monitor information can be used to automatically switch over from a faulty to a standby Tx/Rx unit, to turn off a faulty transmitter that exceeds the maximum allowable output power, or to detect deterioration and aging before a disastrous condition occurs. Alarm settings can be selected at the front panel keypad, remotely via RS-232C interface or via IEEE-488 bus (optional).

The optional trigger input enhances the monitor to provide TDMA and radar test capability.



Typical Installation of Radar Performance Monitoring System



MONITOR SERIES SPECIFICATIONS

Noise Figure Monitoring:	
Noise figure measurment range	0 to 15 dB (with 15.5 dB ENR noise source)
Instrument accuracy	+/-0.1 dB (at NF of 0 to 7 dB)
Noise source drive	+28 V
Measurement time	30 µs
Trigger input (for TDMA and radar applications)	2 - 50 V into 1 kohm
Trigger pulse length	0.5 µs minimum
Trigger to measure delay	Programmable from 60 µs
Input connector	50 ohm BNC female
IF input level	-79 to -33 dBm
IF input VSWR	1.5:1 maximum
IF input frequency	30, 60, or 70 MHz (any frequency between 5 and 150 MHz upon request)
IF input bandwidth	10% of center frequency or customer specified
Power and VSWR Monitoring:	
Accuracy	+/-0.3 dB (plus 2% of FSD)
Power range	Up to 3 kW depending on coupler value
Inserrtion loss	0.15 dB maximum
VSWR	Typically less than 1.05:1
Directivity	25 dB minimum
Typical frequency ranges (other customer specified ranges are available upon request)	824 — 928 MHz 1710 — 1930 MHz 2400 — 2485 MHz 2700 — 3100 MHz 3700 — 4200 MHz 5400 — 5900 MHz 8600 — 9500 MHz 10500 — 13000 MHz
General:	
Required line voltage	115/230 VAC +/-10%, 48-400 Hz, 50 VA maximum
Dimensions	485 mm W x 135 mm H x 128 mm D (19 in. W x 5.3 in. H x 12.8 in. D)
Operating temperature range	0° to +55°C

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Noise Figure and Gain Measurements

.se figure and gain measurements can be made by using a noise source and simple power ratio measurements. Noise figure is defined as:

$$NF\ (\text{in dB}) = 10\log\left(\frac{T_e + 290}{290}\right)$$

where T_e is the noise temperature of the device under test (DUT). The noise figure can be measured using the Y-factor method:

$$NF\ (\text{in dB}) = ENR - 10\log(Y - 1)$$

where Y is the ratio of the output power of the DUT with the noise source on to the output of the DUT with the noise source off:

$$Y = \frac{PON1}{POFF1} = \frac{k\,(T_h + T_e)\,B\,G_m\,G_a}{k\,(T_c + T_e)\,B\,G_m\,G_a}$$

and:

k = Boltzmann's constant = 1.380×10^{-23} J/K
T_h = output power of the noise source when turned on
= $290 \times [1 + 10^{(ENR/10)}]$ in degrees K
T_c = ambient room temperature in degrees K
B = the noise bandwidth of the measurement system
G_m = the available gain of the test set-up (not in dB)
G_a = the available gain of the DUT (not in dB)

To measure the gain, two additional measurements are necessary. The noise source is connected directly to the test set-up and the power levels (P_{ON2} and P_{OFF2}) are measured with the noise source turned on and the off. These measurements eliminate the bandwidth, gain, and noise figure of the test set-up from the gain equation. They are typically performed when the test set-up is calibrated.

$$Ga = \frac{P_{ON1} - P_{OFF1}}{P_{ON2} - P_{OFF2}}$$

where:

$P_{ON2} = k\,(T_h + T_m)\,B\,G_m$
$P_{OFF2} = k\,(T_c + T_m)\,B\,G_m$
T_m = the noise temperature of the test set-up

The condition for the elimination of the bandwidth from the gain equation is that the bandwidth of the test set-up is smaller than the bandwidth of the DUT. Noise Com's NPR and Monitor Series are available with customer-specified bandwidth. The NCT Series performs the measurements in a bandwidth determined by the associated spectrum analyzer. These Noise Com instruments are capable of performing measurements on very narrowband devices such as wireless communications components.

For ambient temperatures much different than 290 K (17°C), a correction factor (10logA) should be added to the right side of the Y-factor noise figure equation, with A defined as:

$$A = 1 - [(T_c/290) - 1] \times [Y/10^{(ENR/10)}]$$

The correction is most significant when measuring low noise figures and it can usually be disregarded in order to simplify the measurement. Second-stage correction only needs to be calculated when the output noise of the DUT is within 10 dB of the noise figure of the test set-up (eg.: G_a (dB) + NF (dB) - 10 < NFm (dB). Corrections for second-stage effects (the test set-up noise figure) can be made using the following equation:

$$F_{actual} = F_{measured} - [(F_m - 1)/G_a]$$

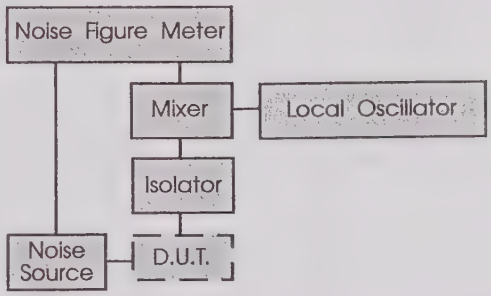
where:

F_{actual} = the actual noise factor of DUT (not in dB)
$F_{measured}$ = the measured noise factor (not in dB)
F_m = the noise factor of the test set-up (not in dB)

Impedance mismatch between the DUT, the noise source, and the test set-up can also lead to measurement uncertainty. The impedances should be kept as close to 50 ohms as possible by using well matched test equipment and a noise source with minimum variation of the output impedance as it is switched from on to off. Noise sources with built-in isolators are ideal for less than octave frequency ranges and noise sources with built-in attenuators are best for wider than octave band applications.

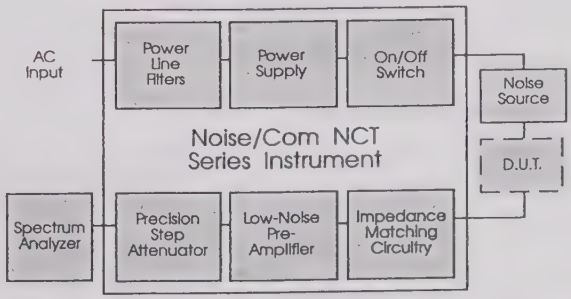
Low frequency noise figure test equipment can be extended to higher frequency testing by adding an external mixer and local oscillator (LO) as shown in Figure 1. Noise Com offers noise sources for frequencies from 10 KHz to 110 GHz (see the NC 346 Series on page 14).

Figure 1. Block diagram of noise figure meter with components for extended frequency range.



The isolator in Figure 1 can be replaced by a 6 to 10 dB attenuator for broadband measurements. The extended frequency measurements are double sideband. That is, they include the sum of the noise from the two sidebands located at the LO frequency plus and minus the intermediate frequency (IF).

Figure 2. Noise Figure Measurement Set-up Using Spectrum Analyzer and a Noise Com NCT Series Instrument.



The NCT Series on page 15, is a single sideband noise figure and gain front-end for a spectrum analyzer. The spectrum analyzer memory can be used to store the P_{OFF} trace. The RF power entering the spectrum analyzer is kept constant, which eliminates the spectrum analyzer nonlinearity by changing the attenuation of the NCT from 0 to Y dB as the noise source is switched from off to on. The P_{ON} trace will then lineup with the stored P_{OFF} trace and the Y factor (in dB) is read directly on the precision attenuator of the NCT.

Broadband Calibrated Noise Sources For Noise Figure Measurements

NC 346 Series
10 kHz to 60 GHz

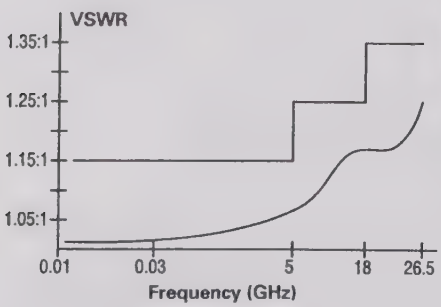
Features:

- Noise output on and off times less than 20 and 80 μs respectively in repetitive operation. Single-shot turn on time less than 3 ms.
- VSWR less than 1.15:1 from 10 MHz to 5 GHz for units with 5 to 7 dB or 14 to 16 dB ENR
- Temperature coefficient less than 0.009 dB/°C
- Noise output variation with voltage less than 0.002 db/%ΔV
- Operating temperature 0°C to +55°C
- Input power +28 VDC ±2 VDC at 15 mA typical for NC 346 A, B, & D
- Built-in regulator

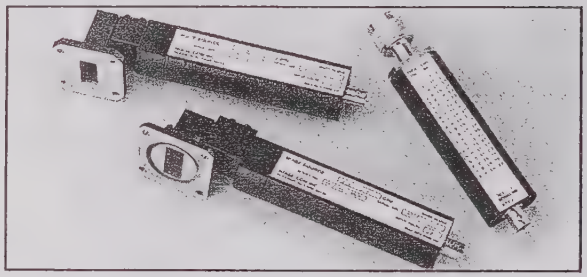
Noise Com's NC 346 Series is designed for precision noise figure measurement applications. The VSWR has been improved, reducing multiple reflections of the test signals and significantly increasing the measurement accuracy of most noise figure set-ups.

The NC 346 Series noise sources have broadband coverage and extremely good temperature and voltage stability, which makes them the finest noise figure meter compatible laboratory standards. Outputs of 6, 15.5 and 22 dB ENR are available, allowing the units to accurately measure noise figures up to 20, 30 and 36 dB respectively.

The return loss of the noise sources is measured in both the on and off states and is included in the calibration report provided with each noise source. Each noise source is also supplied with calibration data traceable to NIST.



Typical VSWR for NC 346C



NC 346 COAXIAL SERIES

NOISE COM MODEL	RF CONNECTOR	FREQUENCY (GHz)	OUTPUT ENR (dB)	VSWR (MAXIMUM @ ON/OFF)			
				0.01-5 GHz	5-18 GHz	18-26.5 GHz	26.5-40 GHz
NC 346 Y	SMA Male	10 kHz — 1 GHz	14 to 16	1.20:1			
NC 346 A	SMA Male	0.01 — 18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Precision	APC3.5 Male	0.01 — 18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Option 1	N Male	0.01 — 18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Option 2	APC7	0.01 — 18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Option 4	N Female	0.01 — 18.0	5 to 7	1.15:1	1.25:1		
NC 346B	SMA Male	0.01 — 18.0	14 to 16	1.15:1	1.25:1		
NC 346B Precision	APC3.5 Male	0.01 — 18.0	14 to 16	1.15:1	1.25:1		
NC 346B Option 1	N Male	0.01 — 18.0	14 to 16	1.15:1	1.25:1		
NC 346B Option 2	APC7	0.01 — 18.0	14 to 16	1.15:1	1.25:1		
NC 346B Option 4	N Female	0.01 — 18.0	14 to 16	1.15:1	1.25:1		
NC 346 C	APC3.5 Male	0.01 — 26.5	13 to 17	1.15:1	1.25:1	1.35:1	
NC 346 D	SMA Male	0.01 — 18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Precision	APC3.5 Male	0.01 — 18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Option 1	N Male	0.01 — 18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Option 2	APC7	0.01 — 18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Option 3	N Female	0.01 — 18.0	19 to 25*	1.50:1	1.50:1		
NC 346 E	APC3.5 Male	0.01 — 26.5	19 to 25*	1.50:1	1.50:1	1.50:1	
NC 346 Ka	K Male**	0.10 — 40.0	10 to 17	1.25:1	1.30:1	1.40:1	1.50:1
NC 346 V	V Male***	TBD — 60.0	TBD to 17	Consult Factory			

* Flatness better than ±2 dB
** Compatible with SMA and APC3.5
*** Compatible with APC2.4

NC 346 WAVEGUIDE SERIES WITH BUILT-IN ISOLATOR*

Noise Com Model	Flange	Frequency (GHz)	ENR (dB)	VSWR (on/off)
NC 346B WR 229	CPR229F	3.7 — 4.2	-14 to 16**	1.15:1
NC 346B WR 90	M3922/59-008	8.5 — 9.6	14 to 16**	1.15:1
NC 346B WR 75	UBR 120	10.5 — 13.0	14 to 16**	1.15:1

* Inquire for other flanges or waveguide sizes
** Flatness better than +/-0.15 dB

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Instruments for Noise Figure Measurement

CT 6000 Series
10 kHz to 18 GHz

Features:

- Low cost
- High resolution
- Attenuator accuracy to 0.05 dB
- Wide frequency bands between 10 kHz and 18 GHz

Noise Com's new NCT 6000 Series instruments are designed exclusively for noise figure measurements. The instruments contain a calibrated white noise source, low-noise preamplifier, impedance-matching circuitry, precision 11-dB step attenuator with 0.1 dB resolution, power-conditioning supplies for 115 VAC, and switches needed to perform noise figure measurements when using a spectrum analyzer.

All models are supplied with calibration data versus frequency for both ENR and noise figure.

Standard connectors are SMA, with BNC or N connectors optionally available. Supply voltage of 230 VAC is optional as well. Standard instrument dimensions are 8.5 in. W x 5 in. H x 12.25 in. D. The instruments can also be supplied 17 in. W x 3.5 in. H x 13 in. D for rack mounting.

Options:

1. Additional 110-dB attenuator in 1-dB steps*
2. 230 VAC
3. 17 in W x 3.5 in. H x 13 in. D chassis
4. N connectors
5. BNC connectors
6. 75-ohm impedance

* Used for reducing output power only when testing large gain or large bandwidth devices, not for the noise figure measurement.

Each NCT 6000 Series instrument comes with a coaxial cable and a noise source covering the input frequency range. Supplementary noise sources, such as 10 kHz to 10 GHz and 10 MHz to 18 GHz, are available.

NCT 6000 Series

MODEL	INPUT FREQUENCY BAND	ENR (dB)*	GAIN FLATNESS (dB)
NCT 6107	10 kHz — 100 MHz	9.5±0.5	±0.5
NCT 6108	10 kHz — 500 MHz	9.5±0.5	±0.5
NCT 6109	30 MHz — 1 GHz	9.5±0.5	± 0.5
NCT 6110	30 MHz — 1.5 GHz	9.5±0.5	±0.5
NCT 6112	30 MHz — 2 GHz	9.5±0.5	± 0.75
NCT 6124	2 GHz — 4 GHz	9.5±0.5	± 1.25
NCT 6218	2 GHz — 18 GHz	9.25±0.75	± 1.5

Specifications

LNA	Input VSWR	1.5:1 maximum
	Noise figure	7 dB maximum*, 5 dB typical
	Gain	50 dB nominal
	1 dB gain compression	+8 dBm
ATTENUATOR	Range	11 dB
	Resolution	0.1 dB
	Accuracy	±0.05 dB over 1-dB range to 1 GHz ±0.25 dB over 11 dB range
GENERAL	Noise figure measurement range:	0.1 dB to 25 dB
	Noise source VSWR	1.25:1 maximum
	Impedance	50 ohms
	Connectors	SMA female
	Input power	115 VAC, 60 Hz, 500 mA
	Size	127 mm H x 216 mm W x 311 mm D (5 in. H x 8.5 in. W x 12.25 in. D)
	Operating temperature	-10°C to +50°C

* Calibration points supplied with each unit

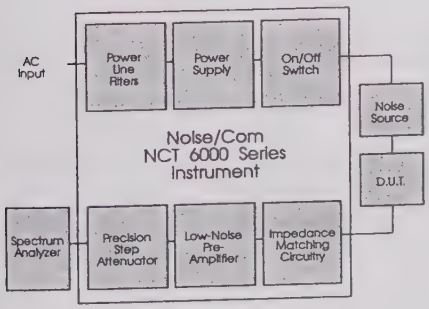


Figure 1. Noise Figure Management Set-Up Using Spectrum Analyzer and a Noise Com NCT 6000 Instrument

Testing with the Noise Power Ratio Method

Amplifier linearity is a key parameter in modern communication systems. Both the low noise amplifier (LNA) in a handheld receiver and the power amplifiers in base stations are loaded simultaneously with a multitude of carriers. These many carrier signals generate intermodulation distortion in the amplifiers. The noise power ratio method is an accurate means of reproducing this effect and accurately determining the amplifier's performance under different loading conditions.

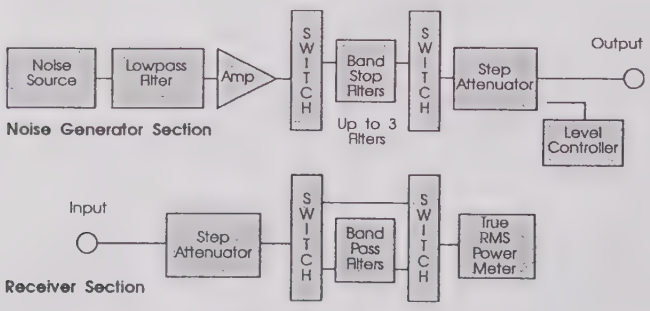
A long-standing test of intermodulation distortion is the two tone test. Here, two in-band signals, usually of the same amplitude, are injected into the amplifier and the third order product amplitude is measured. However, this test has many shortcomings for a system which is loaded by many signals. First, the distortion product amplitude may be dependent on the spacing of the input signals. Second, the amplifier will perform differently when loaded with many signals, as opposed to just two signals. The noise power ratio method emulates a scenario of many signals by loading the amplifier with white noise. In this way, all combinations of carrier frequencies are taken into account, and a true worst case measurement is made.

Intermodulation distortion manifests itself in two primary ways. In a receiver LNA, adjacent channel signals cause in band distortion products. For a transmitter power amplifier, distortion of the primary signal will cause interference in adjacent channels, a phenomenon known as spectral regrowth. Both cases are closely related and can be accounted for with the noise power ratio test.

NPR is a measure of distortion produced in a particular band by a device which is loaded with white noise. Measurement of NPR versus input power, or loading, is used to define the optimum operating point for maximum signal-to-noise ratio. The NPR measurement plus a noise figure measurement defines the maximum spurious-free dynamic range of a device.

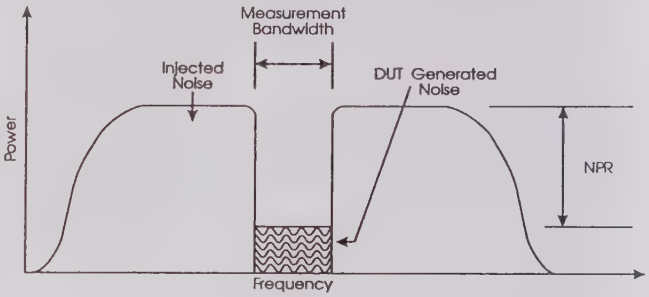
The UFX-NPR performs this test automatically with a very high degree of accuracy.

Block Diagram of UFX-NPR Series Test Set



An internal noise generator with a known output power and bandwidth is used to load the amplifier at a desired level. A notch filter can be inserted in the noise generator path. The receiver section of the UFX-NPR measures the output power from the amplifier in a band which falls inside the notch bandwidth. The receiver measures the power in that band before and after the notch is inserted. The difference between those two measurements is the NPR ratio. The UFX-NPR automatically corrects for the loading change as the notch is inserted.

Output Noise Spectrum During NPR Measurement



The NPR is degraded primarily by two factors. One is the distortion products which are produced under high loading conditions. The second is the noise floor of the amplifier which will become dominant under very low loading conditions. By making numerous such measurements at different loading levels, a curve will be generated as shown in the figure below.

NPR Versus Loading

The NPR is poor at low loading levels because the amplifier is being operated near its own noise floor. This noise is also known as the intrinsic noise. The NPR will increase at approximately one to one as the loading level is increased above the intrinsic noise. The NPR is also poor at very high loading levels. But the slope on this side of the curve is steeper since here the distortion products dominate, and they tend to increase at a two to one rate with loading level.

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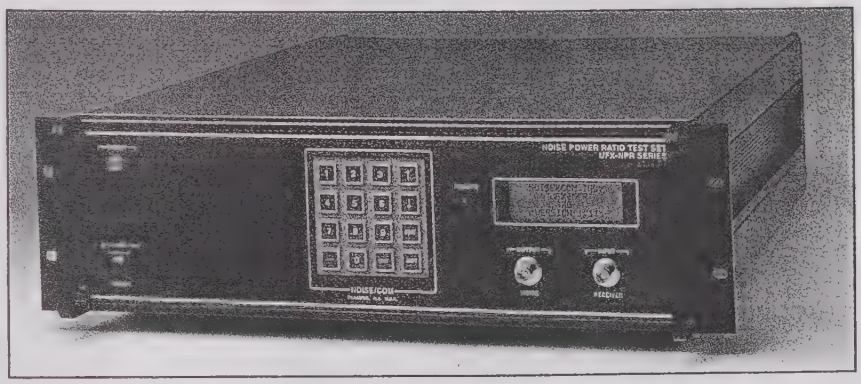
(201) 261-8797 • FAX (201) 261-8339

Amplifier Noise Power Ratio (NPR) Test Station

UFX-NPR Series
300 Hz to 40 GHz

Features:

- Direct display of NPR and noise power level
- Automatic level control to within ±0.1 dB
- Increment and decrement routines
- IEEE-488 interface
- Intrinsic and distortion measurements



The UFX-NPR Series Instruments perform automatic distortion measurements in mobile telephone (CDMA and FDM) base stations, satellite communications systems, and other equipment operating in multi-signal or FDM environments.

An accurate level of white noise power is applied to the device under test (DUT). A bandstop (notch) filter is then inserted to create a "quiet" channel. The noise power measured in the "quiet" channel at the output of the DUT is due to thermal noise and intermodulation distortion introduced by the DUT. Automatic level control maintains the applied noise power level within ±0.1 dB of initial setting at constant ambient temperature when switching filters.

The output power of the DUT within the notch bandwidth is measured with a built-in precision NPR power meter. The NPR is the ratio between the noise power measured with the notch filter inserted before the DUT to that measured without a notch filter. The NPR value is calculated and displayed in dB on the front panel. The result is automatically separated into intrinsic and distortion components. All controls and measurement values are available for the IEEE-488 bus.

Tabular NPR versus loading curves are automatically generated simply by specifying start and stop parameters. The instrument sweeps the specified range with up to 25 points per sweep. The results are stored and the optimum loading condition is automatically identified. The results can be viewed on the front panel or transferred via the IEEE-488 interface.

Option 7 creates a complete amplifier test station by adding the capability to measure noise figure and gain. An internal precision noise standard is gated on and off, and the noise figure and gain are calculated using techniques similar to a traditional noise figure meter.

Options:

1. N/A
2. N/A
3. 230 VAC, 50 Hz instead of standard 110 VAC, 60 Hz
4. Switched "filter" bank, provides 3 sets of SMA female connectors for notch and bandpass filters on the rear panel.
5. RS-232, RS-422, or RS-423 interface in addition to IEEE-488
6. 75-ohm impedance
7. Noise figure and gain measurement

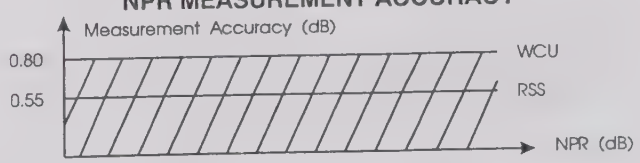
UFX-NPR SERIES

Model	Frequency Range
UFX-NPR-70	50 — 90 MHz
UFX-NPR-140	100 — 180 MHz
UFX-NPR-1700	1.6 — 1.9 GHz
UFX-NPR-2400	2.2 — 2.6 GHz
UFX-NPR-3900	3.6 — 4.2 GHz
UFX-NPR-11900	10.95 — 12.8 GHz

GENERAL SPECIFICATIONS

Noise output power, programmable	-60 dBm to 0 dBm
Output resolution	0.1 dB
Output leveling	±0.1 dB
Crest factor	5:1 (14 dB) minimum
Output connector	BNC female (SMA or K above 2 GHz)
Typical VSWR	1.5:1 into 50 ohms
Flatness	±1 dB for 70 MHz (±20 MHz)
Dimensions	7 in. W x 5.25 in. H x 21.5 in. D
Mounting	Brackets including for 19 in. rack mounting
Operating temperature	-10°C to +65°C
NPR accuracy	±0.80 dB WCU ±0.55 dB RSS
NPR range	0 to 40 dB minimum
Standard notch depth	40 dB at ±15 kHz

NPR MEASUREMENT ACCURACY



NOISE/COM E. 49 Midland Avenue, Paramus, New Jersey 07652
(201) 261-8797 • FAX (201) 261-8339

VXIbus Programmable Noise Generators for ATE

VXI 7000 Series
10 Hz to 40 GHz

General Specifications:

Output	White Gaussian noise
Attenuator	0 to 127 dB in 1 dB steps (0.1 dB steps optional)
Attenuator switching time	5 ms typical
Impedance	50 ohms (others optional)
Typical VSWR	1.5:1
Standard ouput connector	SMA female (K female for UFX 7240)
Dimensions	2.4 in. wide x 9.2 in. high x 13.4 in. deep Double slot, C-size
Power	+5 V at 1 A +12 V at 1 A +24 V at 1 A
Operating temperature	0 to +55°C

Application:

- ATE systems

Features:

- Message-based interface
- VXIbus Revision 1.3
- SCPI compatible

The VXI 7000 Series instruments contain a Noise Com amplified noise source that is tuned to provide the best flatness at the instrument output. The amplifier is optimized to deliver an unsaturated output with a Gaussian amplitude distribution. Noise output power level can be adjusted from 0 to 127 dB in 1 dB (and optionally 0.1 dB) steps.

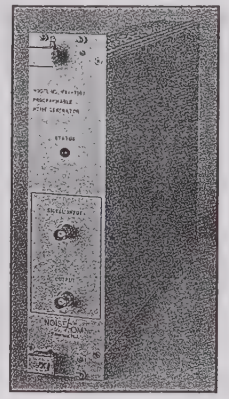
The output state is controlled by an RF switch. In the standby state, the noise is terminated into an RF load and in the on-state it is directed to the output connector.

The instrument's flexible architecture allows many options to be specified.

Switched filter bank: Allows up to four filters in the noise path. The filters can be specified in any combination of bandpass, lowpass, highpass, or notch. A thru line and set of terminations (RF loads) are also included.

Output combiner: Makes it possible for the user to add a controlled amount of noise to the signal.

Signal attenuator: Available in 0.1 or 1 dB steps to 127 dB.



VXI 7100, VXI 7200 SERIES

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dB)	µV/√Hz
VXI 7101	10 Hz — 20 kHz	+13	-30	±0.5	7071.00
VXI 7103	10 Hz — 500 kHz	+13	-44	±0.5	1414.00
VXI 7105	10 Hz — 10 MHz	+13	-57	±0.5	316.00
VXI 7107	100 Hz — 100 MHz	+13	-67	±0.75	100.00
VXI 7108	100 Hz — 500 MHz	+10	-77	±1.0	31.6
VXI 7109	100 Hz — 1000 MHz	+10	-80	±1.5	22.4
VXI 7110	100 Hz — 1500 MHz	+10	-82	±1.5	18.2
VXI 7111	1 GHz — 2 GHz	+10	-80	±1.5	22.4
VXI 7112	1 MHz — 2 GHz	+0	-93	±2.0	5.0
VXI 7124	2 GHz — 4 GHz	-10	-103	±2.0	1.58
VXI 7218	2 GHz — 18 GHz	-20	-122	±2.0	0.18
VXI 7240	2 GHz — 40 GHz	-20	-126	±4.0	0.11

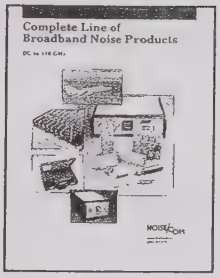
Options:

1. N female output connector
2. BNC female output connector
3. 0 to 128 dB noise attenuator in 0.1 dB steps
4. Switched filter bank: 4 filters, 1 thru, 1 termination. Remote switching to four filters for subbands
5. N/A
6. 75 ohm output impedance
7. Combiner for input signal (6 dB loss in noise and signal paths)
8. Dual outputs
9. Special configuration
10. N/A
11. N/A
12. 0 to 127 dB signal attenuator in 1 dB steps
13. 0 to 128 dB signal attenuator in 0.1 dB steps

NOISE/COM
E. 49 Midland Avenue, Paramus, New Jersey 07652
(201) 261-8797 • FAX (201) 261-8339

Broadband Noise Component Catalog

Noise Com, Inc. designs and manufactures a complete line of broadband noise components. The "Complete Line of Broadband Noise Products" catalog can be obtained from your Noise Com representative or by calling Noise Com at (201) 261-8797. The catalog contains information about the following noise components and products.



IMC Series, 30 MHz - 18 GHz

The former International Microwave Corporation (IMC) noise source product line was acquired by Noise Com, Inc. in 1990. These noise sources are now manufactured to the original drawings by Noise Com, Inc.

MC Series, 10 MHz - 40 GHz

The former MSC (Microwave Semiconductor Corporation/ Siemens/Thomson CSF) noise source product line was acquired by Noise Com, Inc. in 1992. These noise sources are now manufactured to the original drawings by Noise Com, Inc.

NC 100 - NC 400 Series, 0.1 Hz - 110 GHz

Noise diode chips, beam-lead packaged noise diodes for surface mount applications, DO-35 glass packaged noise diodes, and other styles.

NC 346 Series, 10 MHz - 60 GHz

Calibrated multi-octave coaxial noise sources for noise figure measurement applications. Noise figure meter compatible.

NC 346WR Series, 3.6 - 4.2 GHz, 10.5 - 12.5 GHz etc.

Calibrated noise sources with waveguide output, built-in isolator, and current regulator for precision noise figure measurements on low-noise amplifiers and LNBs.

NC 500 Series, 200 kHz - 5 GHz

TO-8 noise modules for built-in test (BIT) applications.

NC 1000 Series, 10 Hz - 6 GHz

Amplified noise modules in connectorized packages. Output power to +13 dBm; many options available.

NC 2000 Series, 100 Hz - 2 GHz

Amplified noise modules in Dual-In-Line packages (DIPs) for built-in test applications.

NC 3200 Series, 10 kHz - 18 GHz

OEM coaxial noise sources, 23 to 27 dB ENR. Packaged for tough enviroments. Optionally screened to MIL-STD-883.

NC 3400 Series, 2 GHz - 18 GHz

High ENR coaxial noise sources calibrated with built-in isolators for ATE and applications.

NC 3408 Series, 2 GHz - 18 GHz

Multi-octave calibrated coaxial noise source and coupler assemblies for radar warning receiver and ATE applications.

NC 5000 Series, 18 GHz - 110 GHz

Calibrated waveguide noise sources for radiometer and noise figure meter applications.

NC 6000 Series, 10 Hz - 40 GHz

Bench-top manually-controlled noise generators for general purpose use. Includes step attenuator and power supplies.

NC 8000 Series, 500 Hz - 1 GHz

High-power (1 W average output power) noise generators for electromagnetic susceptibility and jamming applications.

UFX 7000 Series, 10 Hz - 40 GHz

Broadband programmable noise generators with IEEE-488 (GPIB) interface. General purpose bench-top and 19 in. rack mount applications.

All of above products produce symmetrical, white Gaussian noise. OEM products are also available. Please contact the factory.

NOISE/COM
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Certification

Noise Com, Inc., certifies that its products meet published specifications at the time of shipment from the factory. Noise Com, Inc., further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST) to the extent allowed by the bureau's calibration facility, and to the calibration facilities of other International Standard Organization (ISO) members.

Rights and Advises

Noise Com, Inc., reserves the right to make changes without notice in the devices or the device specifications identified in this publication. Customers are advised to obtain the latest version of the device specifications before placing an order to verify that the information relied on is current.

Specifications obtained in this publication supersede all data for these products published by Noise Com, Inc., prior to October 1993.

Warranty and Assistance

All Noise Com products are warranted against defects in material and workmanship for a period of one year from the date of shipment. Noise Com will, at its option, repair or replace products that prove to be defective during the warranty period, provided they are returned to Noise Com, and provided the preventive maintenance procedures are followed. Repairs necessitated by misuse of the product are not covered by this warranty. No other warranties are expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Noise Com is not liable for consequential damages.

NOISE/COM

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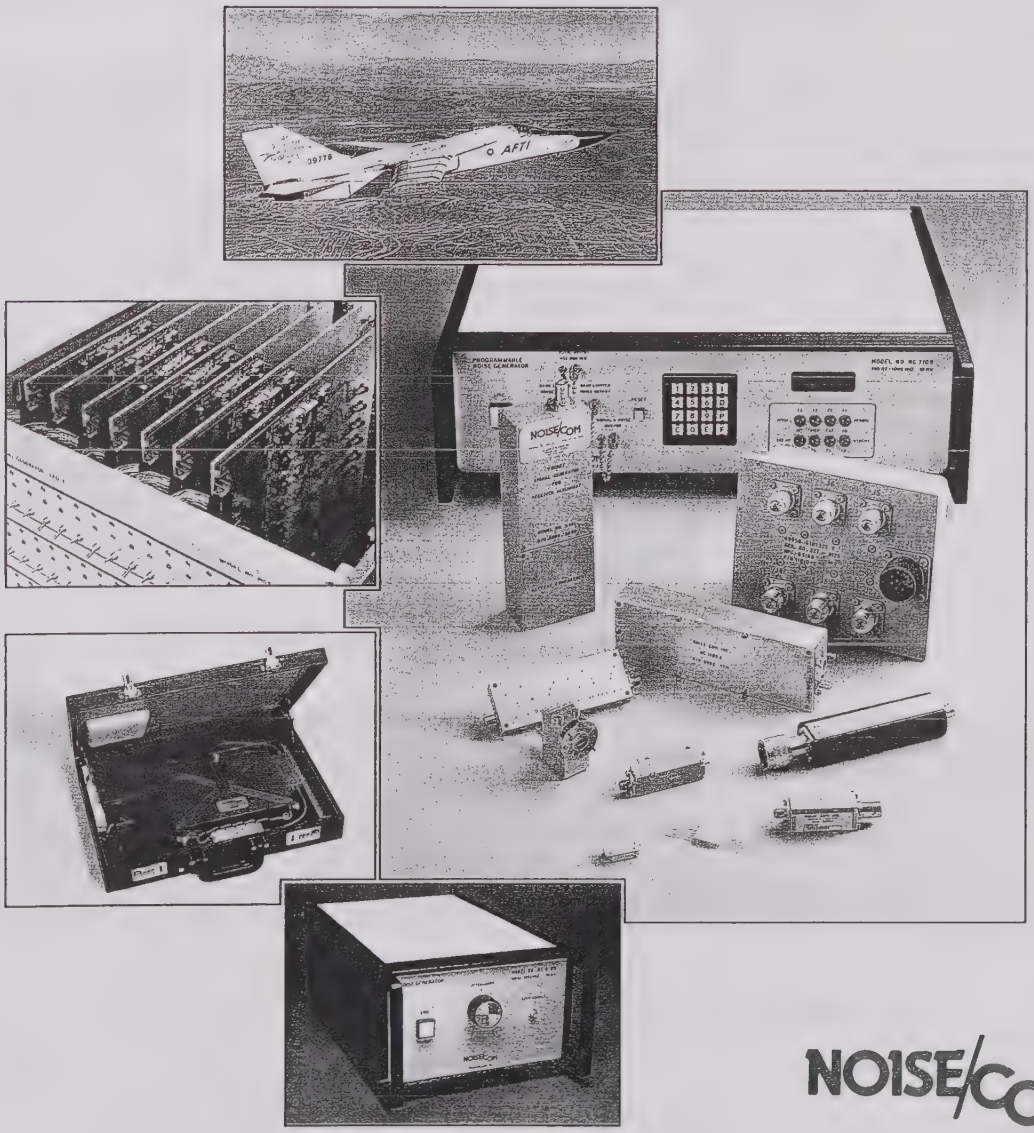
Complete Line of Broadband Noise Products

DC to 110 GHz



NOISE/COM

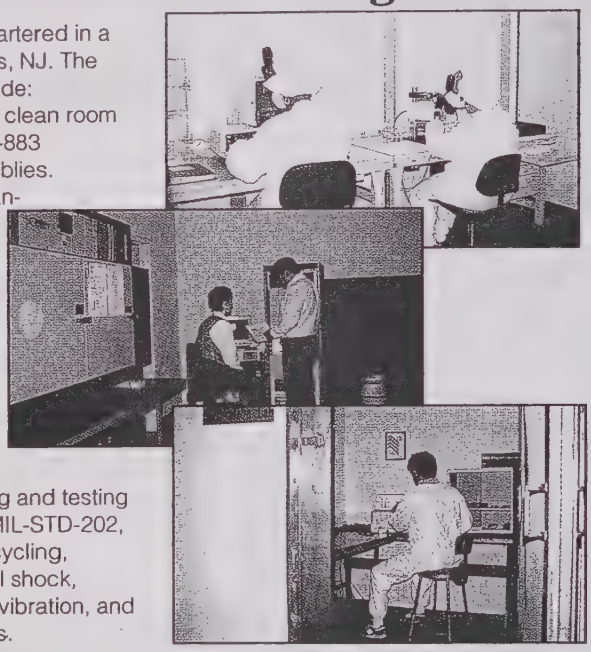
Noise Components
(201) 261-8797

Noise Com Meets the Tough Challenges Head On

Noise Com,, Inc., is headquartered in a 12,000 ft.^{2} facility in Paramus, NJ. The company's capabilities include:

- 150 sq. ft. Class 10,000 clean room for hybrid and MIL-STD-883 microelectronics assemblies.
- Computer-aided mechanical design and PC board layout system supplemented by circuit simulation and software emulation capabilities.
- MIL-I-45208 inspection system with ISO-9000 certification anticipated in the near future.
- Environmental screening and testing per MIL-STD-883 and MIL-STD-202, including temperature cycling, thermal and mechanical shock, random and sinusoidal vibration, and gross and fine leak tests.
- In-house certified instructors, inspectors, and assemblers for the MIL-STD-2000 workmanship standard. ESD protection is to MIL-STD-1686 and MIL-HDBK-263.
- EMI shielded MIL-C-45662 calibration department with standards traceable to NIST.

All catalog and OEM products benefit from Noise Com's comprehensive in-house facilities. These capabilities combined with service-minded technical personnel provide Noise Com with the ability to manufacture high-reliability products and test equipment for frequencies up to 110 GHz.



Noise Com noise sources and noise subsystems are being used throughout the world to evaluate the performance of the military and commercial, radar, satellite communications, and data transmission systems.

Noise Com has established a solid reputation for quality, performance, and product support that is among the most highly regarded in the industry. We have recently enhanced our facilities and equipment to increase the precision of our calibration, measurement, and testing capabilities and we hope that you will benefit from this.

If You Don't See It—Ask For It

Noise Com routinely designs and manufactures custom components, subsystems, and even complete systems in extremely short times. In fact, our efforts have been commended in writing by some of the largest and most critical systems manufacturers in the US.

So if you don't see a product in this catalog that meets your requirements, just ask for it—call a Noise Com representative at (201) 261-8797 or fax us at (201) 261-8339.

Express

24-hr. Guaranteed Delivery Available

Noise Com, Inc., offers you quick delivery of components and instruments. The Express symbol in this catalog identifies products that we'll ship to you within 24-hr. (one working day) ARO . . . guaranteed. The 24-hr. guarantee applies to limited quantities and excludes weekends and holidays. Express service is also available for our calibration service and other products that may be in stock at the time the order is placed.

Noise Com acquired the noise source product line of International Microwave Corp. (IMC) in 1990, and acquired the former Microwave Semiconductor Corp./Siemens/Thomson CSF noise product line in 1992. Noise Com manufactures the following noise sources (and many others) to the original drawings:

NOM-80100-31	MC-51000 Series	MC-7000 Series	MC-1000 Series
MC-5000 Series	MC-200/201	MC-52000 Series	MC-50000 Series

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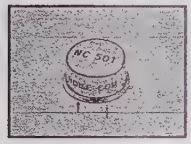
A Noise Product for Every Application

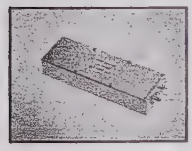
Components

NC 100 to NC 400 Series Noise Diodes
0.1 Hz to 110 GHz
Page 4

NC 346 Series Calibrated Coaxial and Waveguide Noise Sources for Noise Figure Measurement 10 kHz to 60 GHz
Page 5

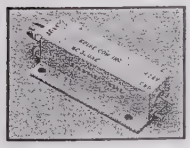


NC 500 Series TO-8 Drop-in Noise Modules
200 kHz to 5 GHz
Page 6

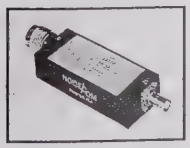


NC 1000 Series Connectorized Amplified Modules 10 Hz to 6 GHz
Page 7

NC 2000 Series Dual-in-line Amplified Modules 100 Hz to 2 GHz
Page 8



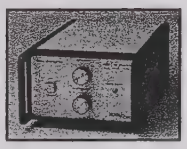
NC 3200 Series Calibrated Coaxial Noise Sources for OEM and Military Applications 10 kHz to 18 GHz
Page 8



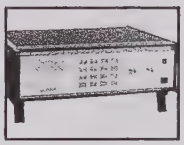
NC 3400 Series Coaxial Noise Sources with Built-in Isolators and NC 3408A/ NC 3408B Series Noise Source Coupler Assemblies 2 GHz to 18 GHz
Page 9

NC 5000 Series Millimeter-wave Noise Sources 18 GHz to 110 GHz
Page 10

Instruments



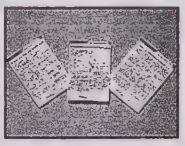
NC 6000 and NC 8000 Series Broadband General Purpose Noise Generators
10 Hz to 40 GHz
Page 11



UFX 7000 Series Programmable Multi-purpose Noise Generators
10 Hz to 40 GHz
Page 12

Calibration Service,
DC to 110 GHz
Page 13

Application Notes



Noise Basics
Built-in Test
Page 14

Package Dimensions and Outline Drawings

Page 16

Noise Com Communication Test Equipment

Page 19

Noise Conversion Chart

Page 20

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Noise Diodes

NC 100 Through NC 400
0.1 Hz to 110 GHz

Features:

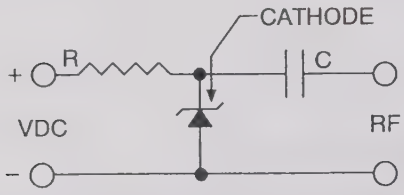
- Five package options
- Flat output
- Operating temperature 0 to +55°C for NC 100 Series, -55 to +125°C for all others
- Storage temperature -65 to +150°C
- Meet MIL-STD-750

Noise Com's noise diodes are the fundamental building blocks of all noise systems. They are hand-picked for performance characteristics that make them ideally suited to broadband noise generation with flat response.

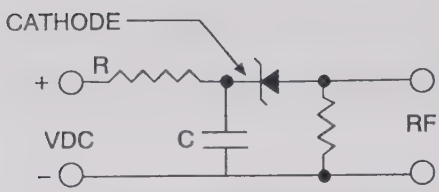
All Noise Com noise diodes deliver symmetrical white Gaussian noise and flat output power versus frequency. The diodes are burned-in for 168 hours, meet MIL-STD-202, and are hermetically sealed. Noise Com noise diodes are available in a wide variety of package styles, and in special configurations on request.

The NC 100 and NC 200 series diodes are designed for audio and RF applications. The NC 300 and NC 400 series diodes are designed for microwave applications in which a 50-ohm impedance is required.

See page 16 for package styles and dimensions.

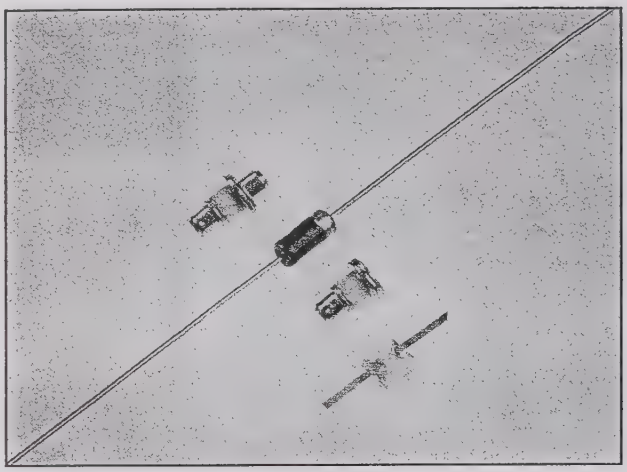


LOW-FREQUENCY BIAS CIRCUIT
(< 4 GHz)



HIGH-FREQUENCY BIAS CIRCUIT
(> 4 GHz)

$$R = \frac{V_{DC} - V_b}{I_{op}} \qquad C \geq \frac{1}{2\pi \cdot \text{frequency}}$$



Express

AUDIO & VHF TYPES

MODEL	FREQUENCY RANGE	OPERATING CONDITIONS			MINIMUM OUTPUT (μV/√Hz)	PACKAGE
		V_b (V)	I_{op}	RL (Ω)		
NC 101	0.1 Hz — 100 kHz	7-10	30-60 μA	2200	3.0	DO-35
NC 102	0.1 Hz — 500 kHz	7-10	30-60 μA	2200	3.0	DO-35
NC 103	0.1 Hz — 1 MHz	7-10	30-60 μA	2200	3.0	DO-35
NC 104	0.1 Hz — 3 MHz	7-10	30-60 μA	2200	3.0	DO-35
NC 201	0.1 Hz — 10 MHz	7-10	0.2-0.5 mA	2200	0.1	DO-35
NC 202	0.1 Hz — 25 MHz	7-10	0.2-0.5 mA	2200	0.1	DO-35
NC 203	0.1 Hz — 100 MHz	7-10	0.2-0.5 mA	50	0.05	DO-35
NC 204	0.1 Hz — 500 MHz	13-15	1 mA	50	0.05	DO-35

RF & MICROWAVE TYPES

MODEL	FREQUENCY RANGE	OPERATING CONDITIONS			OUTPUT	PACKAGE*		
		V_b (V)	I_{op} (mA)	RL (Ω)	ENR (dB)			
NC 301	10 Hz — 1.1 GHz	13-15	1-4	50	32-37	DO-35		
NC 302	10 Hz — 3 GHz	8-12	6	50	30-35	DO-35	BL	CH1
NC 302L	10 Hz — 3 GHz	6- 8	6	50	30-35	DO-35	BL	CH1
NC 303	10 Hz — 8 GHz	8-12	8	50	30-35	DO-35	BL	CH1
NC 304	10 MHz — 12.4 GHz	16-21	12	50	30-35	DO-35		CH1
NC 305	10 MHz — 11 GHz	8-12	10	50	29-34		BL	CH1
NC 401	100 MHz — 18 GHz	8-12	10	50	30-35	C10	C50H	CH2
NC 403	100 MHz — 27 GHz	8-12	12	50	24-28	C50		CH3
NC 404	18 GHz — 50 GHz	8-12	15	50	20-25	C50		CH3
NC 405	18 GHz — 75 GHz	8-12	20	50	15-25	C50		CH3
NC 406	18 GHz —110 GHz	8-12	30	50	15-25			CH3

* For chip configuration — Add suffix "C".
For beam lead configuration — Add suffix "BL".
For C50H configuration — Add suffix "H".

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Broadband Calibrated Noise Sources For Noise Figure Measurements

NC 346 Series
10 kHz to 60 GHz

Features:

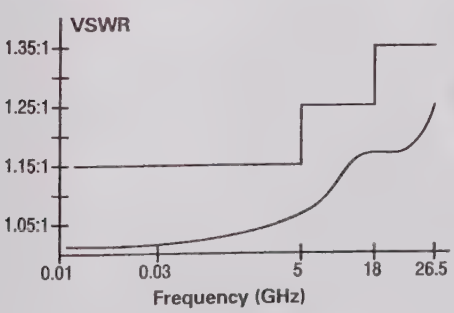
- Noise output on and off times less than 20 and 80 µs respectively in repetitive operation. Single-shot turn on time less than 3 ms.
- VSWR less than 1.15:1 from 10 MHz to 5 GHz for units with 5 to 7 dB or 14 to 16 dB ENR
- Temperature coefficient less than 0.009 dB/°C
- Noise output variation with voltage less than 0.002 db/%ΔV
- Operating temperature 0°C to +55°C
- Input power +28 VDC ±2 VDC at 15 mA typical for NC 346 A, B, & D
- Built-in regulator

Noise Com's NC 346 Series is designed for precision noise figure measurement applications. The VSWR has been improved, reducing multiple reflections of the test signals and significantly increasing the measurement accuracy of most noise figure set-ups.

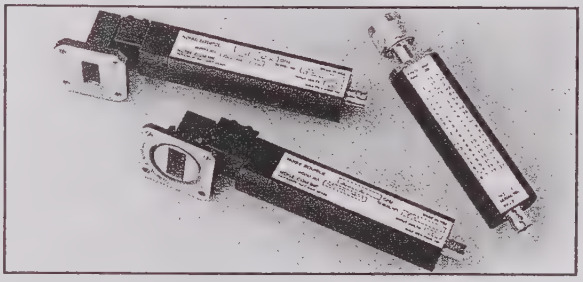
The NC 346 Series noise sources have broadband coverage and extremely good temperature and voltage stability, which makes them the finest noise figure meter compatible laboratory standards. Outputs of 6, 15.5 and 22 dB ENR are available, allowing the units to accurately measure noise figures up to 20, 30 and 36 dB respectively.

The return loss of the noise sources is measured in both the on and off states and is included in the calibration report provided with each noise source. Each noise source is also supplied with calibration data traceable to NIST.

See page 16 for package styles and dimensions.



Typical VSWR for NC 346C



Express

NC 346 COAXIAL SERIES

NOISE COM MODEL	RF CONNECTOR	FREQUENCY (GHz)	OUTPUT ENR (dB)	VSWR (MAXIMUM @ ON/OFF)			
				0.01-5 GHz	5-18 GHz	18-26.5 GHz	26.5-40 GHz
NC 346 Y	SMA Male	10 kHz - 1 GHz	14 to 16	1.20:1			
NC 346 A	SMA Male	0.01-18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Precision	APC3.5 Male	0.01-18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Option 1	N Male	0.01-18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Option 2	APC7	0.01-18.0	5 to 7	1.15:1	1.25:1		
NC 346 A Option 4	N Female	0.01-18.0	5 to 7	1.15:1	1.25:1		
NC 346B	SMA Male	0.01-18.0	14 to 16	1.15:1	1.25:1		
NC 346B Precision	APC3.5 Male	0.01-18.0	14 to 16	1.15:1	1.25:1		
NC 346B Option 1	N Male	0.01-18.0	14 to 16	1.15:1	1.25:1		
NC 346B Option 2	APC7	0.01-18.0	14 to 16	1.15:1	1.25:1		
NC 346B Option 4	N Female	0.01-18.0	14 to 16	1.15:1	1.25:1		
NC 346 C	APC3.5 Male	0.01-26.5	13 to 17	1.15:1	1.25:1	1.35:1	
NC 346 D	SMA Male	0.01-18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Precision	APC3.5 Male	0.01-18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Option 1	N Male	0.01-18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Option 2	APC7	0.01-18.0	19 to 25*	1.50:1	1.50:1		
NC 346 D Option 3	N Female	0.01-18.0	19 to 25*	1.50:1	1.50:1		
NC 346 E	APC3.5 Male	0.01-26.5	19 to 25*	1.50:1	1.50:1	1.50:1	
NC 346 Ka	K Male**	0.10-40.0	10 to 17	1.25:1	1.30:1	1.40:1	1.50:1
NC 346 V	V Male***	TBD-60.0	TBD to 17	Consult Factory			

*Flatness better than ±2 dB
** Compatible with SMA and APC3.5
*** Compatible with APC2.4

NC 346 WAVEGUIDE SERIES WITH BUILT-IN ISOLATOR*

Noise Com Model	Flange	Frequency (GHz)	ENR (dB)	VSWR (on/off)
NC 346B WR 229	CPR229F	3.7 - 4.2	14 to 16**	1.15:1
NC 346B WR 90	UG39/U	8.5 - 9.6	14 to 16**	1.15:1
NC 346B WR 75	UBR 120	10.5 - 13.0	14 to 16**	1.15:1

*Inquire for other flanges or waveguide sizes
** Flatness better than +/-0.15 dB

NOISE/COM
E. 49 Midland Avenue, Paramus, New Jersey 07652
(201) 261-8797 • FAX (201) 261-8339

Drop-in Noise Modules for BITE

NC 500 Series
200 kHz to 5 GHz

Features:

- Economical solution to BITE
- Drop-in TO-8 packages
- 31 dB or 51 dB ENR output
- Minimum crest factor 5:1
- Operating temperature -55 to +85°C
- Storage temperature -65 to +150°C
- Temperature coefficient 0.01 dB/°C
- Noise output rise and fall times less than 0.5 ms

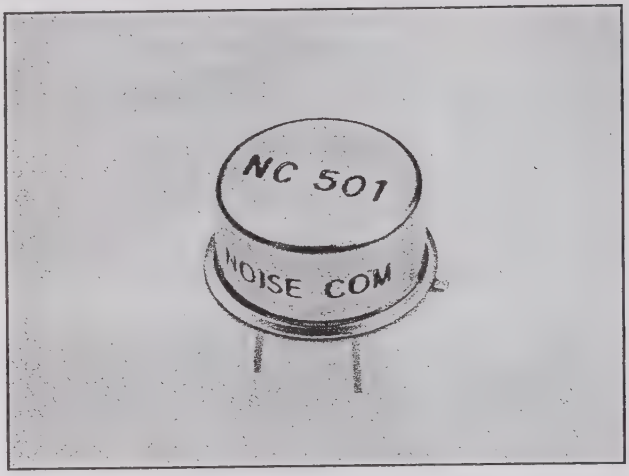
The NC 500 Series drop-in noise modules are an economical solution for built-in test requirements. They contain complete energizing circuits and need no external peripheral devices.

The NC 500 Series modules are housed in a TO-8 metal can, and require 0.2 to 5 mA. The modules produce 31 or 51 dB ENR of white noise with a Gaussian distribution, and are available from stock in ranges to 5 GHz. Like all Noise Com products, they contain a fully characterized noise diode that has been burned-in for 168 hr.

The examples listed are representative of NC 500 Series units for typical applications. Noise Com can optimize frequency range, voltage, and output level of the NC 500 Series for specific applications.

Options:

1. Military version in compliance with MIL-E-5400T Class 2 (add suffix M).



Express

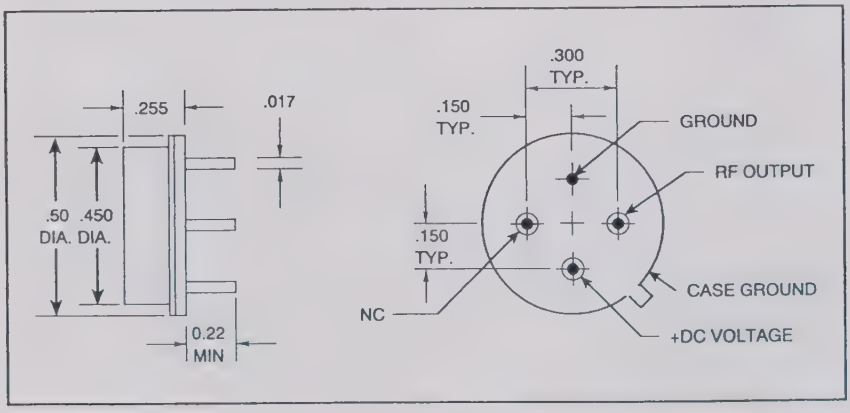
NC 500 SERIES

MODEL FOR +15 V SUPPLY	MODEL FOR +28 V SUPPLY	FREQUENCY RANGE (MHz)	MINIMUM OUTPUT		FLATNESS @ 25°C (dB)
			ENR (dB)	@ R_L (Ω)	
NC 501/15	NC 501	0.2- 500	31	50	±0.5
NC 502/15	NC 502	0.2-1000	31	50	±1.0
NC 503/15	NC 503	0.2-2000	31	50	±1.5
NC 504/15	NC 504	0.2-3000	31	50	±1.5
NC 505/15	NC 505	0.2-4000	31	50	±2.0
NC 506/15	NC 506	0.2-5000	31	50	±2.5

NC 510 SERIES*

MODEL	FREQUENCY RANGE (MHz)	MINIMUM OUTPUT		FLATNESS @ 25°C (dB)
		ENR (dB)	@ R_L (Ω)	
NC 511/15	0.2- 500	51	50	±2.0
NC 512/15	0.2-1000	51	50	±2.0
NC 513/15	0.2-2000	51	50	±2.0

* Requires 20 mA maximum. Commercial version only.



NOISE/COM E 49 Midland Avenue, Paramus, New Jersey 07652
(201) 261-8797 • FAX (201) 261-8339

Amplified Noise Modules

C 1000 Series
10 Hz to 6 GHz

Features:

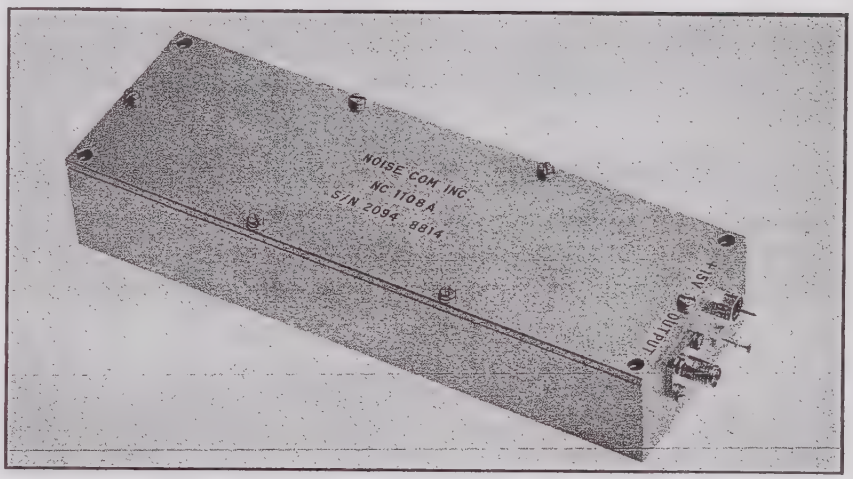
- High power — up to +13 dBm
- Flat response — ±0.5 dB
- Operating temperature -35 to +100°C
- Storage temperature -65 to +150°C
- SMA female connector (BNC available as option)
- Typical temperature coefficient 0.025 dB/°C
- Supply voltage sensitivity 0.25 dB/1%ΔV

The NC 1000 Series amplified noise modules produce white Gaussian noise from -14 dBm to as high as +13 dBm. They are designed for applications that require injection of noise at high levels, such as in CATV, secure communications, and jamming systems.

Each NC 1000 module contains a hermetically-packaged noise diode that has been burned-in for 168 hr. The output of the noise source is connected to an RF amplifier that boosts power to the desired output. See page 17 for package styles and dimensions.

Options:

1. +15 VDC
2. +24 VDC
3. BNC female connector
4. 0 dBm output (package 2)
5. TTL control "high" is on (add suffix T).
6. TTL Control "low" is on (add suffix IT).



50-ohm LOAD IMPEDANCE (PACKAGE 1)

+28 VDC OPERATION IS STANDARD

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dB)	µV/√Hz
NC 1101A	10 Hz- 20 kHz	+13	-30	±0.5	7071
NC 1103A	10 Hz- 500 kHz	+13	-44	±0.5	1414
NC 1105A	10 Hz- 10 MHz	+13	-57	±0.75	316
NC 1107A	100 Hz- 100 MHz	+13	-67	±1.0	100
NC 1108A	100 Hz- 500 MHz	+10	-77	±1.5	31.6
NC 1109A	100 Hz-1000 MHz	+10	-80	±2.0	22.4
NC 1110A	100 Hz-1500 MHz	+10	-82	±2.0	18.2

50-ohm LOAD IMPEDANCE (PACKAGE 3)

+15 VDC OPERATION IS STANDARD

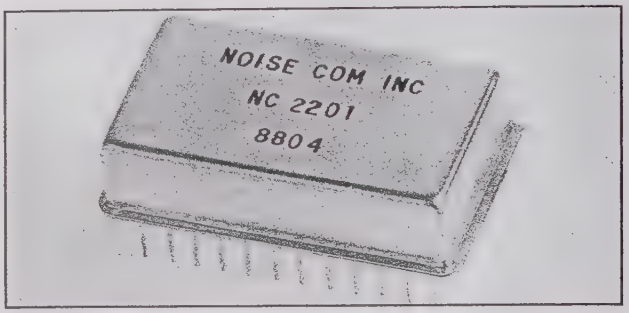
MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dB)	µV/√Hz
NC 1111A	1 GHz - 2 GHz	-10	-100	±2.0	2.24
NC 1111B	1 GHz - 2 GHz	0	-90	±2.0	7.07
NC 1112A	20 MHz - 2 GHz	-10	-103	±2.5	1.58
NC 1112B	20 MHz - 2 GHz	0	-93	±2.5	5.02
NC 1124A	2 GHz - 4 GHz	-10	-103	±2.5	1.58
NC 1126A	2 GHz - 6 GHz	-14	-110	±2.5	0.71

Dual-in-line Amplified Noise Modules

NC 2000 Series
100 Hz to 2 GHz

Features:

- 24-pin packages; 14-pin optional
- Miniumum crest factor 5:1
- High-end roll off 6 dB per octave
- Operating voltage of +15 VDC, +12 VDC optional
- Storage temperature -65 to +125°C
- Operating temperature:
  Commercial -55 to +85°C
  Military -55 to +125°C
- Typical temperature coefficient 0.025 dB/°C



The NC 2000 Series amplified noise modules are an excellent choice when a high-level noise output is desired and the noise source must be mounted on a circuit board.

The NC 2000 Series modules are housed in 24-pin dual-in-line packages.

Modified specifications are also available in 14-pin dual-in-line packages. Consult Noise Com for availability. See page 17 for package styles and dimensions.

Options:

1. Military version in compliance with MIL-E-5400T Class 2 (add suffix M).
2. TTL control "high" is on (add suffix T).
3. Inverted TTL control "low" is on (add suffix IT).
4. 14-pin instead of 24-pin package
5. +12 VDC operating voltage (instead of +15 VDC)

NC 2000 SERIES

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS				LOAD IMPEDANCE (Ω)
		Total Level	Flatness (dB)	dBm/Hz	µV/√Hz	
NC 2101	100 Hz — 20 kHz	0.150 Vrms	±0.75	-63	1061.0	2200
NC 2102	100 Hz — 100 kHz	0.150 Vrms	±0.75	-70	474.0	2200
NC 2105	500 Hz — 10 MHz	0.150 Vrms	±1.0	-87	47.4	1000
NC 2201**	1 MHz — 100 MHz	+5 dBm	±0.75	-75	40.0	50
NC 2401**	1 MHz — 500 MHz	0 dBm	±1.0	-87	10.0	50
NC 2501**	1 MHz — 1000 MHz	-5 dBm	±1.0	-95	4.0	50
NC 2601**	1 MHz — 2000 MHz	-5 dBm	±2.0	-98	2.8	50

* Operating temperature range for 14-pin commercial version of the NC 2201 is 0°C to 85°C.

** Crest factor is 2:1 for these models.

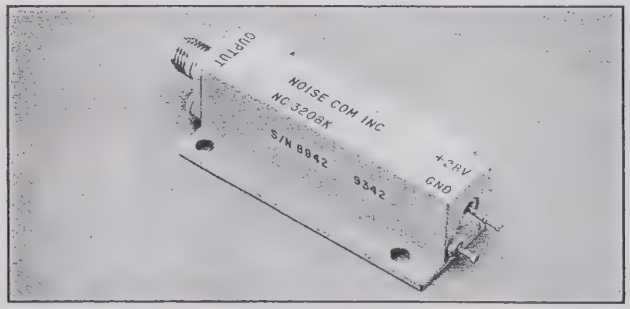
OEM Calibrated Coaxial Noise Sources

NC 3200 Series
10 kHz to 18 GHz

Features:

- Noise output rise and fall times less than 1µs (NC 3208K)
- VSWR less than 3:1
- Noise output variation with temperature less than 0.01 dB/°C
- Noise output variation with voltage less than 0.1 db/1%ΔV
- Operating temperature -55 to +85°C
- Storage temperature -65 to +125°C
- Input power +28 VDC at 20 mA max
- Noise output between 23 to 27 dB ENR

Noise Com's NC 3200 Series calibrated noise sources have excellent stability with temperature and voltage for tough environments. The package is designed for severe environments such as military EW RWR systems. See page 17 for package styles and dimensions.



Express

Options:

1. +15 VDC input voltage
2. MIL-STD-883 screening

HIGH NOISE OUTPUT IMPEDANCE-MATCHED TYPES

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		VSWR	CALIBRATION FREQUENCIES
		ENR (dB)	Flatness (dB)		
NC 3201K	10 kHz — 1	23 - 27	±1	3:1	10, 100, 500, and 1000 MHz
NC 3208K	1 — 18	23 - 27	±1	3:1	1 GHz steps

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Coaxial Noise Sources With Built-in Isolators

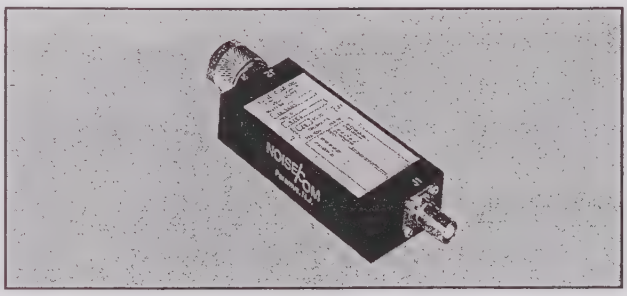
NC 3400 Series
to 18 GHz

Features:

- High ENR: Up to 35 dB
- VSWR less than 1.25:1
- +28 VDC at 20 mA max.
- Flatness to ±0.25 dB for narrowband units
- Noise output rise and fall times less than 1 µs
- Maximum incident RF power 1 W average, 100 W peak
- Excellent choice for applications requiring high ENR and immunity to large incident RF power, such as ATE, radiometer, and radar systems

The calibration accuracy and flatness of the NC 3400 Series noise sources are enhanced by their low VSWR. The built-in isolator provides almost constant output impedance as the noise source bias is switched on and off. The isolator also protects the noise diode from incident RF power (consult factory for higher-power units).

An SMA female connector is standard for the RF output and a BNC female connector is standard for the bias input. Other connectors are available as options (see page 18 package styles and dimensions).



Options:

1. N male output connector
2. SMA male output connector
3. +15 VDC input voltage
4. +28 VDC with regulation. Stabilized output for ±2 V variation
5. TTL control "high" is ON (add suffix T).
6. SMC male bias connector
7. Solder lug for bias connection

MODEL	FREQUENCY (GHz)	ENR (dB)	FLATNESS FULL BAND (dB)**	MAXIMUM VSWR (on/off) *
NC 3404	2 - 4	30 to 36	±0.75	1.25:1
NC 3405	4 - 8	30 to 35	±0.75	1.25:1
NC 3406	8 - 12	28 to 33	±0.75	1.25:1
NC 3407	12 - 18	26 to 32	±0.75	1.25:1

* VSWR for models with N connector is 1.35:1 up to 12 GHz. N connectors are not recommended for frequencies above 12 GHz.

** Flatness for units optimized for bandwidths less than 10 percent of the center frequency is less than ±0.25 dB. Improved VSWR may also be obtained for units with reduced bandwidth.

Calibrated Noise Source Coupler Assemblies

NC 3408A / NC 3408B
2 to 18 GHz

Applications:

- Built-in Test Equipment (BITE)
- Radar Warning Receivers (RWR)
- Automated Test Equipment (ATE)
- Precision (six-port) noise figure meters
- Vector network analyzers
- Spectrum analyzers

The ENR is calibrated at the output of the coupler for these assemblies, providing better measurement accuracy because of the low VSWR at the calibration point. Calibration data for every 1 GHz increment is marked on the side of each assembly.

The assemblies operate from a +28 VDC supply at 20 mA maximum and have noise output rise and fall times of less than 1 µs. An SMA female connector is standard for RF output and solder lug is standard for bias input. See page 18 for package styles and dimensions.

Options:

1. +15 VDC input voltage
2. +28 VDC with regulation. Stabilized output for ±2 V variation.

MODEL	FREQUENCY (GHz)	ENR (dB)*	MAXIMUM VSWR (On/Off)	CHANGE OF ON/OFF REFLECTION	MAXIMUM INSERTION LOSS (dB)
NC 3408A	2 - 18	13 to 17	2.3:1	0.50 Max.	1.3
NC 3408B	2 - 18	3 to 7	1.6:1	0.15 Max.	0.9

* Flatness ±1.25 dB typical

INCIDENT RF POWER*

	NC 3408A	NC 3408B
Average power	5 W	25 W
Peak power at input	600 W	3 kW
Peak power at output	40 W	400 W

* Coaxial coupled noise sources with higher power ratings and waveguide coupled noise sources are available.

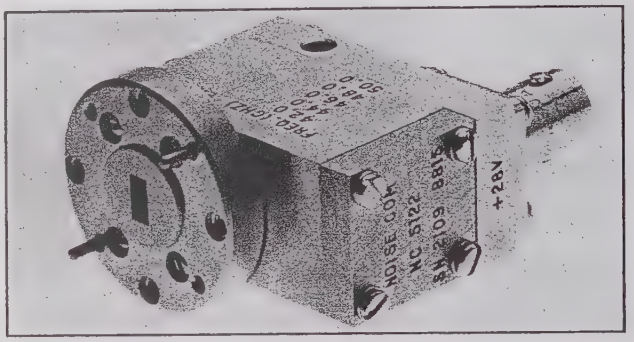
NOISE/COM E. 49 Midland Avenue, Paramus, New Jersey 07652
(201) 261-8797 • FAX (201) 261-8339

Precision Calibrated Millimeter-wave Waveguide Noise Sources

NC 5000 Series
18 to 110 GHz

Features:

- Narrow or wideband performance with low or high output
- Noise output rise and fall times less than 1 μs
- Noise output variation with temperature less than 0.01 dB/°C
- Noise output variation with voltage less than 0.1 dB/1%ΔV
- Operating temperature -55 to +85°C
- Input power +28 VDC at 20 to 30 mA max.



The NC 5000 Series noise sources feature outstanding stability, switching speed, and ripple-free response over standard waveguide bands. The high stability of the NC 5000 Series allows these units to be used in place of cumbersome gas tube noise sources.

Ripple in the output of noise sources has a direct effect on measurement accuracy, so Noise Com has tailored the response of the NC 5000 Series so that ripple is minimized throughout the specified frequency range. Long-term stability is better than 0.05 dB throughout a full year.

The NC 5000 Series is available with noise output of 15.5 dB for instrumentation (noise figure meter) applications, as well as in narrow and full waveguide bands with 15 to 25 dB ENR output. The standard input bias connector is BNC female — others are available.

See page 18 for package styles and dimensions.

Options:

1. +15 VDC
2. TNC bias connector
3. Right-angle BNC bias connector
4. +28 VDC with regulation. Stabilized noise output for ±2 V variation.
5. Output isolator
6. Other waveguide sizes are available on request

NOISE FIGURE METER COMPATIBLE-FULL BAND

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		TYPICAL VSWR	MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
		ENR (dB)	Flatness (dB)				
NC 5142	18 — 26.5	15.5	±0.75	1.3:1	UG595/U	1 GHz steps	WR-42
NC 5128	26.4— 40	15.5	±0.75	1.3:1	UG599/U	1 GHz steps	WR-28
NC 5122	33 — 50	15.5	±1.0	1.3:1	UG383/U	1 GHz steps	WR-22
NC 5119	40 — 60	15.5	±1.0	1.3:1	UG383/U	1 GHz steps	WR-19
NC 5115	50 — 75	15.5	±2.0	1.6:1*	UG385/U	1 GHz steps	WR-15
NC 5110	75 — 110	15.5	±2.0	1.6:1*	UG387/U	1 GHz steps	WR-10

* Maximum VSWR with isolator — option 5.

HIGH NOISE OUTPUT-FULL BAND

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
		ENR (dB)	Flatness (dB)			
NC 5242	18 — 26.5	25.0	±1.0	UG595/U	1 GHz steps	WR-42
NC 5228	26.5— 40	23.0	±2.0	UG599/U	1 GHz steps	WR-28
NC 5222	33 — 50	21.0	±2.0	UG383/U	1 GHz steps	WR-22
NC 5219	40 — 60	20.0	±2.0	UG383/U	1 GHz steps	WR-19
NC 5215	50 — 75	17.0	±2.0	UG385/U	1 GHz steps	WR-15

HIGH NOISE OUTPUT-NARROW BAND

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
		ENR (dB)	Flatness (dB)			
NC 5342	18 — 26.5*	25.0	±0.5	UG595/U	Minimum Center and Maximum	WR-42
NC 5328	26.4— 40*	23.0	±0.5	UG599/U		WR-28
NC 5322	33 — 50*	21.0	±0.5	UG383/U		WR-22
NC 5319	40 — 60*	20.0	±0.5	UG383/U		WR-19
NC 5315	50 — 75*	17.0	±0.7	UG385/U		WR-15
NC 5310	75 — 110*	11.0	±0.7	UG387/U		WR-10

* Bandwidths of 1 GHz may be specified anywhere in the band. Other bandwidths may be specified. However, wider bandwidths may result in a different flatness specification.

NOISE/COM E. 49 Midland Avenue, Paramus, New Jersey 07652
(201) 261-8797 • FAX (201) 261-8339

Broadband General Purpose Noise-Generators

NC 6000 and NC 8000 Series 10 Hz to 40 GHz

Features:

- High power — up to 1 W (+30 dBm)
- Precision attenuator
- Excellent flatness
- Symmetrical white Gaussian noise

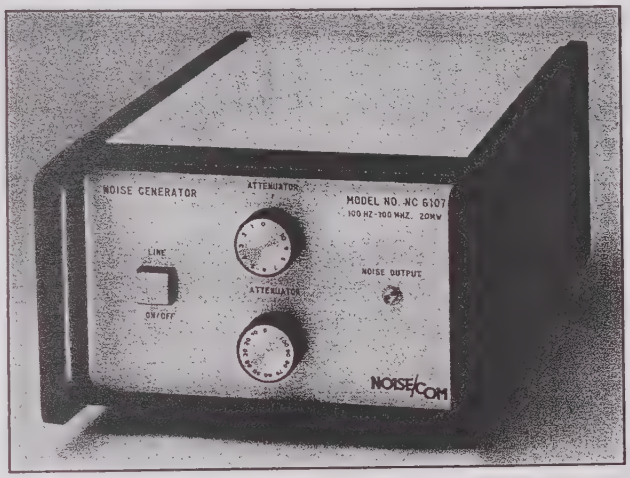
The NC 6000 and NC 8000 Series noise generating instruments are designed for applications on the test bench, or in test stations in which an NC 6000 or NC 8000 Series unit is incorporated with other equipment that provides a wide variety of functions.

Each instrument contains a Noise Com precision noise source that delivers repeatable, symmetrical white Gaussian noise. The noise source is integrated with an amplifier, 10 dB attenuator with 1 dB steps, and power supply. The instruments have a 50 ohm output impedance. The NC 6101B has 600 ohm impedance and is available on request.

The NC 6000 Series units measure 8.5 in. wide by 5 in. high by 12.25 in. deep. The NC 8000 Series units measure 17 in. wide by 5.25 in. high by 13 in. deep and they come with brackets for 19 in. rack mounting. Power requirements are 115 VAC, 60 Hz, at 500 mA. Operating temperature range is from -10 to +60°C. Standard output connector is SMA; others are available.

Options:

1. 100 dB attenuator in 10 dB steps instead of standard 10 dB attenuator in 1 dB steps
2. 110 dB attenuator in 1 dB steps (two attenuators)
3. Line power 230 VAC, 50 Hz
4. Combiner for input signal. (Loss of 6 dB in noise and signal paths.)
5. Marker Input
6. 19 in. rack mountable unit measuring 17 in. wide by 3.5 in. high by 13 in. deep
7. N female output connector
8. BNC female output connector
9. 75 ohm output impedance (6 dB loss)
10. Additional 1 dB attenuator in 0.1 dB steps (was option # 4 for the NC 8000 Series)



NC 6000 SERIES — HIGH OUTPUT

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dB)	µV/√Hz
NC 6101	10 Hz — 20 kHz	+13	-30	±0.5	7071
NC 6103	10 Hz — 500 kHz	+13	-44	±0.5	1414
NC 6105	10 Hz — 10 MHz	+13	-57	±0.75	316
NC 6107	100 Hz — 100 MHz	+13	-67	±1.0	100
NC 6108	100 Hz — 500 MHz	+10	-77	±1.5	31.6
NC 6109	100 Hz — 1000 MHz	+10	-80	±2.0	22.4
NC 6110	100 Hz — 1500 MHz	+10	-82	±2.0	18.2
NC 6111	1 GHz — 2 GHz	+10	-80	±2.0	22.4
NC 6112	1 MHz — 2 GHz	0	-93	±2.5	5.01
NC 6124	2 GHz — 4 GHz	-10	-103	±2.5	1.58
NC 6218	2 GHz — 18 GHz	-20	-122	±3.0	0.18
NC 6240	2 GHz — 40 GHz	-20	-126	±5.0	0.11

NC 8000 SERIES, +30 dBm (1 Watt) OUTPUT

MODEL	FREQUENCY RANGE	OUTPUT (dBm/Hz)	FLATNESS (dB)
NC 8103	500 Hz — 500 kHz	-27	±2
NC 8105	500 Hz — 10 MHz	-40	±2
NC 8107	250 KHz — 100 MHz	-50	±2
NC 8108	1 MHz — 200 MHz	-53	±2
NC 8109	1 MHz — 300 MHz	-55	±2
NC 8110	2 MHz — 500 MHz	-57	±2
NC 8111	5 MHz — 1 GHz	-60	±3

NOISE/COM E. 49 Midland Avenue, Paramus, New Jersey 07652
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Programmable Multi-purpose Noise Generators

UFX 7000 Series
10 Hz to 40 GHz

General Specifications:

Output	White Gaussian noise
Attenuator	0 to 127 dB in 1 dB steps (0.1 dB steps optional)
Attenuator switching time	5 ms typical
Impedance	50 ohms (others optional)
Typical VSWR	1.5:1
Standard output connector	SMA female (K female for UFX 7240)
Dimensions	17 in. wide x 5.25 in. high x 12.5 in. deep
Mounting	Front panel handles and fold down feet for bench mounting. Brackets included for 19 in. rack mounting.
Power	115 VAC, 60 Hz (230 VAC, 50 Hz optional)
Operating temperature	-10 to +65°C

Applications:

- Electromagnetic susceptibility
- Filter testing
- CATV gain (tilt) alignment
- Image and spurious rejection tests

The new UFX 7000 Series noise-generating instruments are extremely easy to use, combining dedicated keys for control of operations and programming with a large 4 x 20 character LCD display for instant status information. The instruments are direct replacements for Noise Com's NC 7000 Series instruments.

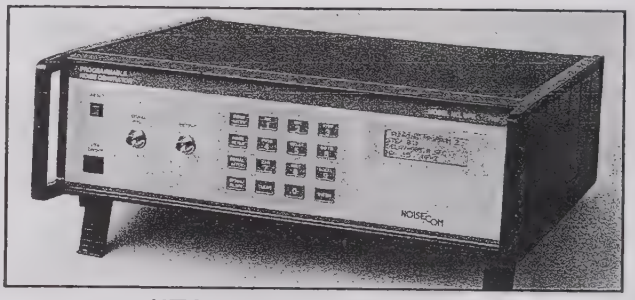
The UFX 7000 Series instruments contain a Noise Com amplified noise source that is tuned to provide the best flatness at the instrument output. The amplifier is optimized to deliver an output with a Gaussian amplitude distribution. Noise output power level can be adjusted from 0 to 127 dB in 1 dB (optionally 0.1 dB) steps.

The output state is controlled by an RF switch. In the standby state, the noise is terminated into an RF load and in the ON state is directed to the output connector.

The instrument's flexible architecture allows many options to be specified.

Switched filter bank: Acts on noise, signal, or both and allows up to four filters to be connected. The filters can be specified in any combination of bandpass, lowpass, highpass, or notch. A thru line and set of terminations (RF loads) are also included.

Output combiner: Allows the user to add a controlled amount of noise to a signal.



UFX 7100, UFX 7200 SERIES

MODEL	FREQUENCY RANGE	OUTPUT CHARACTERISTICS			
		Power (dBm)	dBm/Hz	Flatness (dB)	µV/√Hz
UFX 7101	10 Hz — 20 kHz	+13	-30	±0.5	7071
UFX 7103	10 Hz — 500 kHz	+13	-44	±0.5	1414
UFX 7105	10 Hz — 10 MHz	+13	-57	±0.5	316
UFX 7107	100 Hz — 100 MHz	+13	-67	±0.75	100
UFX 7108	100 Hz — 500 MHz	+10	-77	±1.0	31.6
UFX 7109	100 Hz — 1000 MHz	+10	-80	±1.5	22.4
UFX 7110	100 Hz — 1500 MHz	+10	-82	±1.5	18.2
UFX 7111	1 GHz — 2 GHz	+10	-80	±1.5	22.4
UFX 7112	1 MHz — 2 GHz	+0	-93	±2.0	5.0
UFX 7124	2 GHz — 4 GHz	-10	-103	±2.0	1.58
UFX 7218	2 GHz — 18 GHz	-20	-122	±2.0	0.18
UFX 7240	2 GHz — 40 GHz	-20	-126	±4.0	0.11

UFX 7900 SERIES, +30 dBm (1 Watt) OUTPUT

MODEL	FREQUENCY RANGE	OUTPUT (dBm/Hz)	FLATNESS (dB)
UFX 7903	500 Hz — 500 kHz	-27	±2
UFX 7905	500 Hz — 10 MHz	-40	±2
UFX 7907	250 kHz — 100 MHz	-50	±2
UFX 7908	1 MHz — 200 MHz	-53	±2
UFX 7909	1 MHz — 300 MHz	-55	±2
UFX 7910	2 MHz — 500 MHz	-57	±2
UFX 7911	5 MHz — 1 GHz	-60	±3

LabWindows Drivers available from National Instruments

Signal attenuator: Available in 0.1 or 1 dB steps to 127 dB.

The instruments allow a noise attenuator, noise filter, signal attenuator values, step size, and signal filter setting to be selected in three ways: at the front panel keypad, remotely via IEEE-488 bus, or automatically under program control.

Every front panel operation except instrument on/off is programmable. Programs are easily written using the program key and information on the display guides the user through the next steps. Nine user-created programs that contain subroutines, delay times, and loops can be stored in non-volatile memory.

Options:

1. N female output connector
2. BNC female output connector
3. 0 to 128 dB noise attenuator in 0.1 dB steps instead of 127 dB in 1 dB steps
4. Switched filter bank: 4 filters, 1 thru, 1 termination. Remote switching to four filters for subbands.
5. Marker input, coupling value 23 dB
6. 75 ohm output impedance (6 dB loss in the noise path and 12 dB loss in the signal path)
7. Combiner for input signal (6 dB loss in noise and signal paths)
8. Double output terminals
9. Special configuration
10. Line power 230 VAC, 50 Hz
11. RS-232C, RS-422, RS-423, in addition to standard IEEE-488 interface
12. 0 to 127 dB signal attenuator in 1 dB steps
13. 0 to 128 dB signal attenuator in 0.1 dB steps

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Calibration Service

DC to 110 GHz

Features:

- Same day service. If we receive your noise source in the morning, we will ship it in the afternoon.
- NIST traceability
- MIL-C-45662
- Any brand of noise source
- Any frequency between DC and 110 GHz

Noise Com's Calibration Department calibrates coaxial and waveguide noise sources from any manufacturer. The calibration is performed using a radiometer and a set of precision standards. The calibration points are traceable to the National Institute of Standards and Technology (NIST), and the calibration system is in compliance with MIL-C-45662.

Traceability

Noise Com's set of standards are maintained and regularly compared to the standards of NIST using as few transfer standards as possible (Fig. 1).

Accuracy

The accuracy and traceability of Noise Com's standards are constantly being improved in response to new technology and increasingly complex customer requirements. Noise Com maintains the greatest possible accuracy (Fig. 2).

All of Noise Com's noise sources are calibrated at selected frequencies throughout the device bandwidth. Coaxial and waveguide noise sources are supplied with measured data marked on the sides of the devices. To keep the best possible measurement accuracy in noise figure and noise temperature measurements, noise sources should be calibrated once a year.

Recalibration

Noise Com solid-state noise sources have excellent long-term stability, often better than 0.05 dB/yr. However, we recommend that the units used for accurate noise measurements be returned to Noise Com on a yearly basis for recalibration. It is usually a very quick process and recalibrated noise sources are usually returned within one working day.

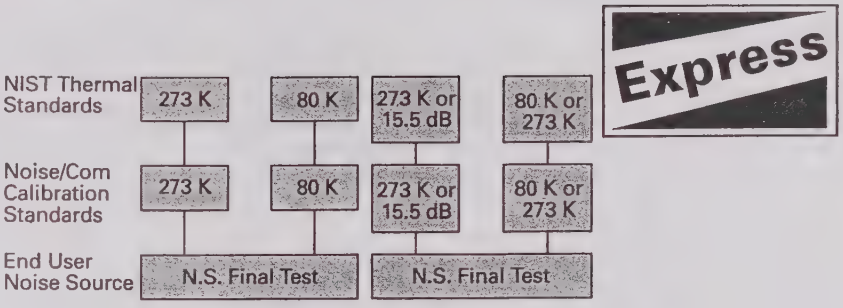

Figure 1. ENR, Noise Temperature, Calibration Traceability to NIST.

Frequency (GHz)	W.C.U. (dB)	Traceable to
0.03	0.24	NIST
3.95	0.28	—
7.50	0.28	—
12.40	0.28	—
18.00	0.28	—

Figure 2. Worst Case Uncertainty, W.C.U., of ENR Calibration for Noise Com, Inc.'s NC 346 Series With VSWR <1.15:1 to 5 GHz and <1.25:1 to18 GHz.

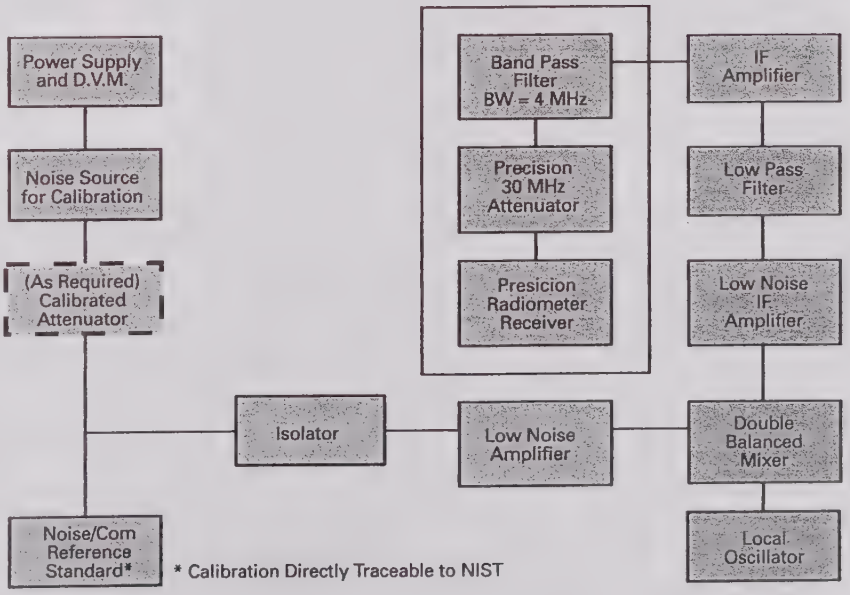

Figure 3. Noise Source Calibration Test Set-up.

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Noise Basics

What Is Noise?

All materials produce noise at a power level proportional to the physical temperature of the material. The noise is generated by random vibrations of conducting electrons and holes in the material. This noise is often referred to as thermal noise. Thermal noise is white and has a Gaussian amplitude distribution.

White Noise

Just as white light includes power at all colors, noise that has its power evenly distributed over all RF and microwave frequencies is called white. The power spectral density of white noise is constant over frequency, which implies that noise power is proportional to bandwidth. So if the measurement bandwidth is doubled, the detected noise power will double (an increase of 3 dB). Thermal white noise power is defined by: $N=kTB$, where N is the noise power available at the output of the thermal noise source, $k = 1.380 \times 10^{-23}$ J/K is Boltzmann's constant, T is the temperature, and B is the noise bandwidth.

Gaussian Noise

Thermal noise is also characterized by having a Gaussian amplitude distribution and is sometimes referred to as white Gaussian noise. Note that Gaussian noise does not have to be white and white noise does not have to be Gaussian. All of the products in this catalog produce white Gaussian noise.

Noise level can be expressed in units of dBm/Hz, V/$\sqrt{Hz}$ or Excess Noise Ratio (ENR). Table 1 (see page 15) contains formulas for conversion between these units.

NC 302LBL for Digital Built-in Test Applications

The most recent CCITT recommendation (G.826) imposes a BIT-Error Rate (BER) of less than 10^{-12} for telephone and communication equipment connected to an international network.

Ten errors are required to obtain a BER estimate with reasonable confidence. At the common ISDN data rate of 64 kbits/sec., it takes about 1 day 19 hr. 24 min. to observe 10 bit errors for a system exhibiting 10^{-9} BER. For a SONET SDH/STM-1 or STS-3 system with a data rate of 155.52 Mbits/sec., it takes 17 hr. 52 min. to confirm a 10^{-12} BER.

These measurement times are for systems operating under conditions at which they are supposed to perform their best. The actual BER depends on the signal-to-noise ratio or more commonly-used E_b/N_o (bit-energy to noise-density ratio). The BER increases about 10 times or more for each 1 dB increase in noise density.

A built-in noise diode such as the NC 302LBL can increase the noise floor (N_o) by 1000 times (30 dB), reducing the BER test time to less than 1 min.

The NC 302LBL is designed for G.826 applications. It covers the most common frequency ranges up to 3 GHz for cellular mobile telephone, ISDN, and SONET. The NC 302LBL operates from most power supplies found in base stations and fiber optic networks due to its low voltage (6 to 8 VDC) and high efficiency.

The NC 302LBL comes in a small microstrip package and is usually placed between the antenna and receiver, or between the photodiode and electronic circuit.

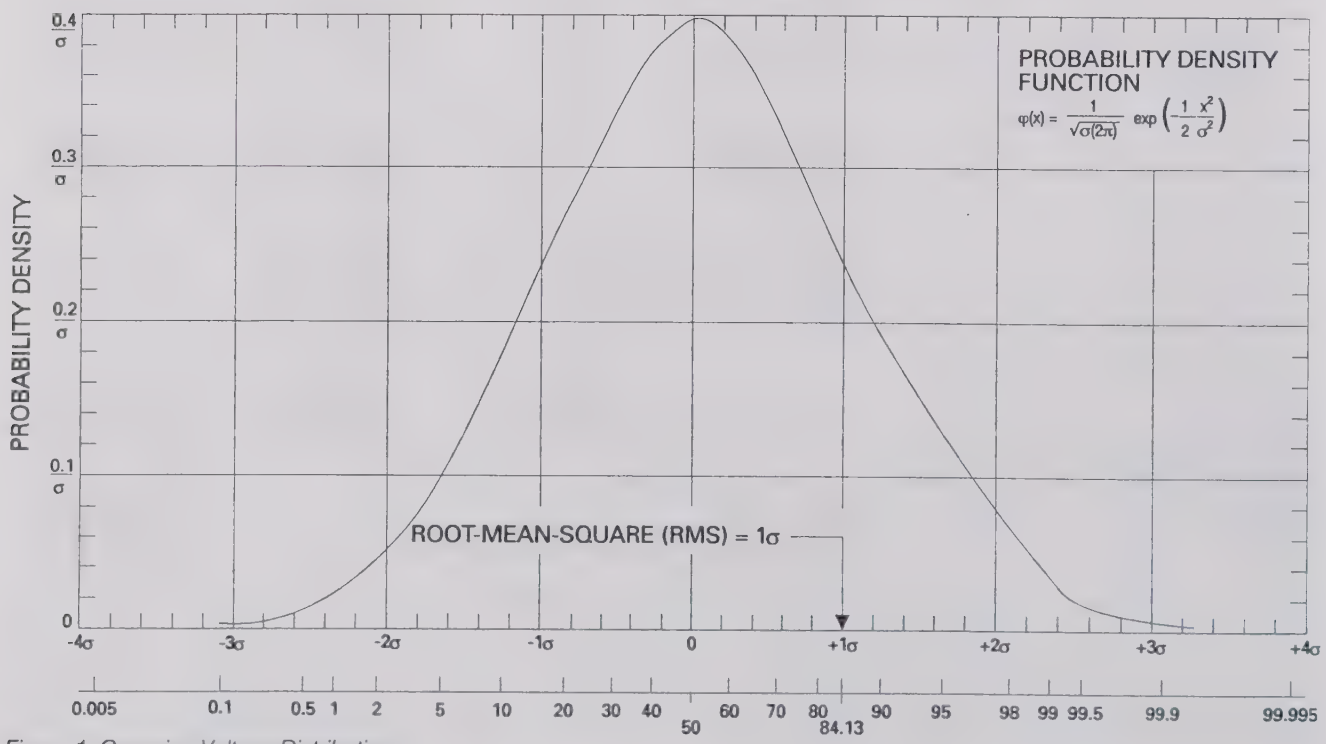

Figure 1. Gaussian Voltage Distribution

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Noise Basics (Continued)

Built-in Test Applications

A noise source that produces white noise is essentially an inexpensive broadband signal generator with an extremely flat (constant) power density output versus frequency. Noise sources are almost insensitive to temperature and supply voltage variations. Noise sources are therefore used for Built-in Testing (BIT), Fault Isolation Testing (FIT), and calibration in communication and radar warning systems to ensure the reliability and performance of the link.

Receiver gain, noise figure, phase tracking, and bandwidth can be measured using built-in noise sources. They may also be used to align the gain and phase balance of I and Q or multichannel receivers, randomizing of the quantization errors of high-speed A/D converters, etc. Using a noise source is faster than most other signal sources because it generates all frequencies simultaneously.

The noise figure is an important measure of the additive noise produced by the receiving system. It is usually desirable to maintain the lowest possible noise figure so that the transmitter's Effective Isotropic Radiated Power (EIRP) can be minimized. It is generally less expensive to lower the noise figure than it is to increase the transmitter power. The noise figure is defined as :

NF (in dB) = ENR-10log(Y-1)

where: $Y=P_{on}/P_{off}$.

P_{on} and P_{off} are the output in watts from the DUT while the noise source is biased on and off respectively. For ambient temperatures much different than 290 K, a correction factor (10logA) should be added to the right-hand side of the above equation with "A" defined as

$$A = 1 - [(T_c/290)-1] \times [Y/10^{(ENR/10)}]$$

The correction is only significant when measuring low noise figures and it can in most cases be disregarded in order to simplify the measurements. Corrections for second-stage effects (the preamplifier plus analyzer noise figure) can be made using the following equation:

$$F_{actual} = F_{measured} - [(F_1-1)/G_a] - [(F_2-1)/(G_a \times G_1)]$$

where:

$$G_a = \frac{P_{oON} - P_{oOFF}}{k \times B \times (Th - Tc)}$$

F_{actual} = the actual noise factor of the DUT (not in dB)
$F_{measured}$ = the measured noise factor (not in dB)
F_1 = the noise factor of the next stage (not in dB)
G_1 = the available gain of the next stage (not in dB)
G_a = the available gain of the DUT (not in dB)
B = noise bandwidth of the measurement system
T_h = 290 x $[1+10^{(ENR/10)}]$ in degrees K
T_c = room temperature in degrees K

The second stage correction needs to be calculated only when the output noise of one stage is within 16 dB of that of the next stage. That is:

$$G_a\ (dB) + NF_{measured}\ (dB) - 16 < NF_{next\text{-}stage}\ (dB)$$

Impedance mismatch between the DUT, the noise source, and the preamplifier leads to measurement ripple, so the measurement accuracy is improved when using a well-matched Noise Com noise source.

Table 1. Useful White Noise Conversion Formulas

dBm	= dBm/Hz + 10log (BW)	
dBm	= 20log (V_{RMS}) - 10log (R) + 30 dB	
dBm	= 20log (V_{RMS}) + 13 dB	for R = 50 ohms
dBm/Hz	= 20log ($\mu V_{RMS}/\sqrt{Hz}$) - 10log (R) - 90 dB	
dBm/Hz	= -174 dBm/Hz + ENR	for ENR > 17 dB

A nomograph summarizing the relationship between these formulas can be found on the back cover of this catalog.

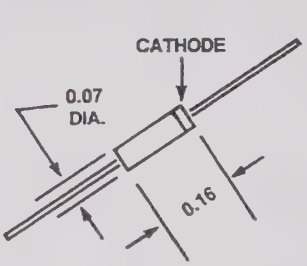
Noise Application Notes

The following Noise Com application notes describing various uses of noise generators are now available. For copies of these notes, please call Noise Com at (201) 261-8797.

Ap Note Number	Title/Description
103	Bit-error rate tests with variable E_b/N_o
104	Noise figure monitoring of hot standby receivers
105	Noise figure measurements using spectrum analyzers
106	BIT of balanced amplifiers
107	Test HDTV and composite TV signals
108	Calibrate receivers and perform built-in tests
109	Noise diodes randomize quantization errors in A/D converters
110	Gain-bandwidth product tests to cut production costs
111	Noise figure measurements below 10 MHz
112	Calibrating spectrum analyzers with a noise source
113	Frequency response of two-port devices and CATV
114	Filter noise bandwidth measurements and calibration
115	Low-cost noise figure measurement
116	Use noise sources to emulate multipath fading
117	Noise Power Ratio (NPR) testing
118	Simulate spread spectrum communication
119	Noise injection radiometers
120	BER testing of digital wireless systems
RFD989	Interference susceptibility testing with white noise
MWJ293	Upgrading a receiver with a noise source
MRF493	Noise simplifies communications tests
ECM	Noise sources as effective ECM tools

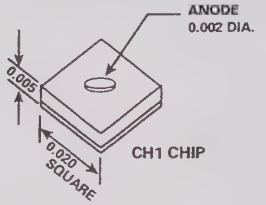
Dimensions and Package Outline Drawings

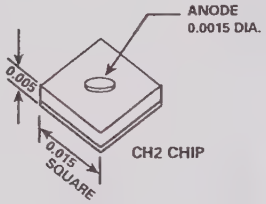
NC 100 — NC 400 Series

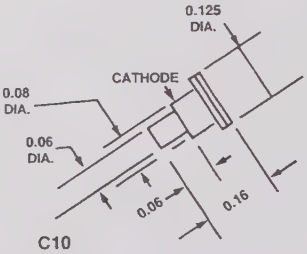


DO-35

C_p = 0.10 pF TYP.
L_S = 1.00 nH TYP.

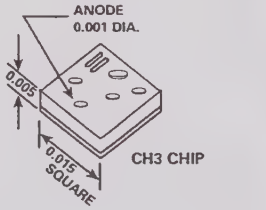


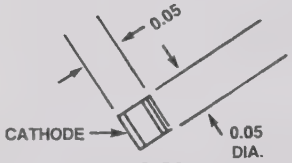




C10

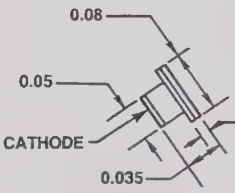
C_p = 0.18 pF TYP.
L_S = 0.40 nH TYP.





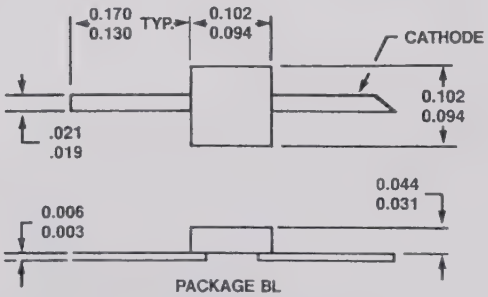
C-50

C_p = 0.13 pF TYP.
L_S = 0.40 nH TYP.



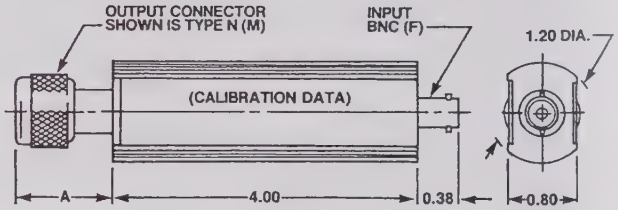
C50H

C_p = 0.23 pF TYP.
L_S = 0.20 nH TYP.

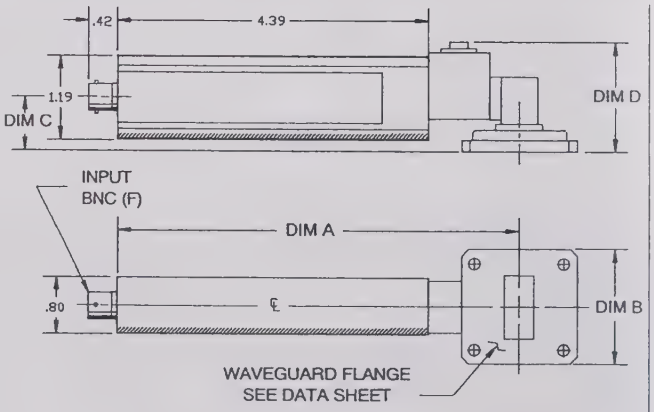


C_p = 0.15 pF TYP.
L_S = 0.40 nH TYP.

NC 346 Series



CONNECTOR	A
N Male	1.14
N Female	0.94
SMA Male	0.50
APC 3.5 Male	0.50
APC 7	1.30
K Male	0.46



WAVEGUIDE FLANGE CHART				
WAVEGUIDE TYPE	DIM A	DIM B	DIM C	DIM D
WR75	5.25	1.50 SQ.	.98	1.60
WR90	5.68	1.68 SQ.	.72	1.50
WR229	6.02	3.87	1.10	2.09

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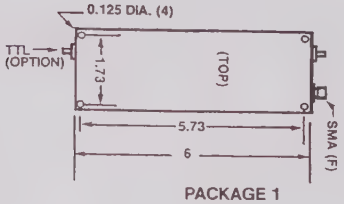
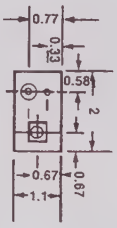
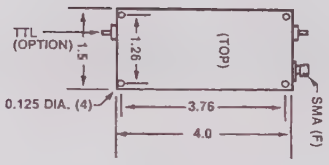
NC 1000 Series



PACKAGE 1





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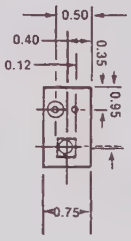

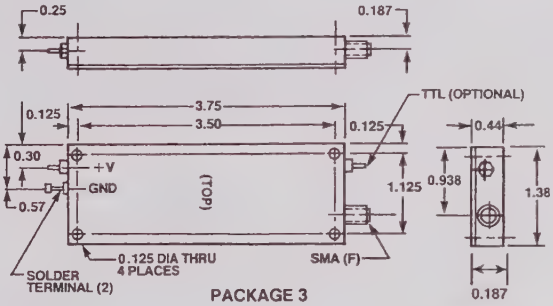

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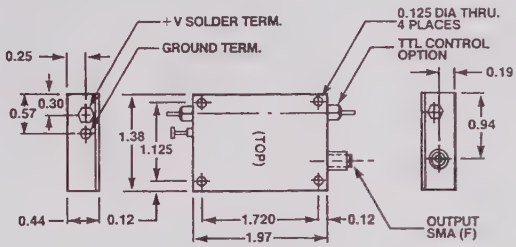
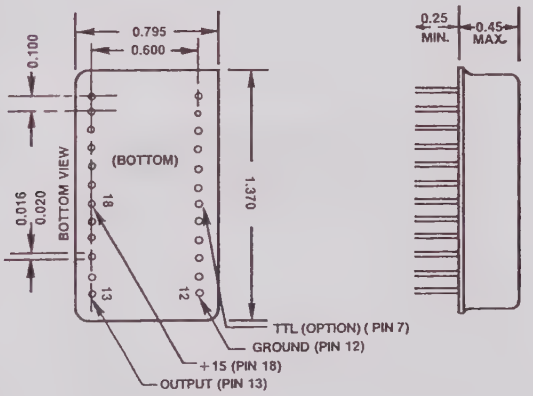
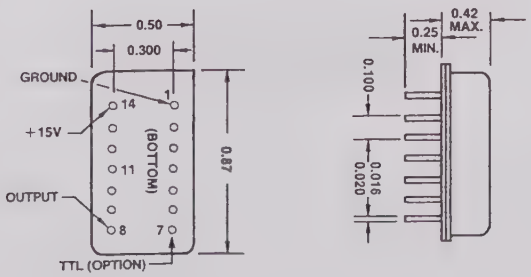


PACKAGE 4

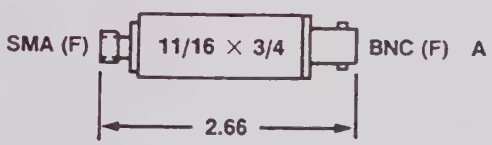
NC 2000 Series

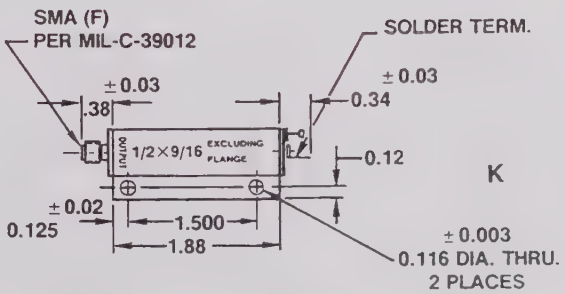




NC 3200 Series

RF CONNECTOR | BIAS CONNECTOR | PACKAGE CODE





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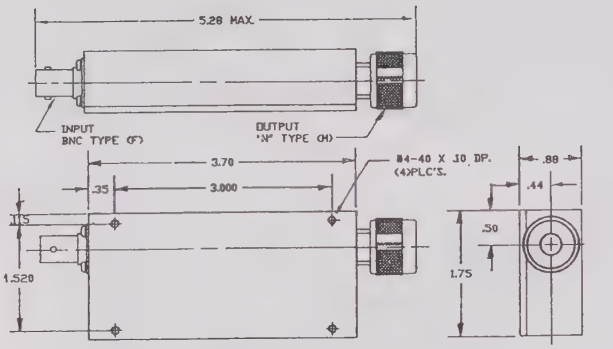
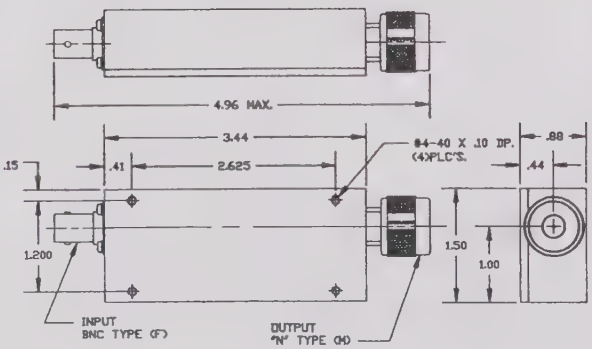
Dimensions and Package Outline Drawings

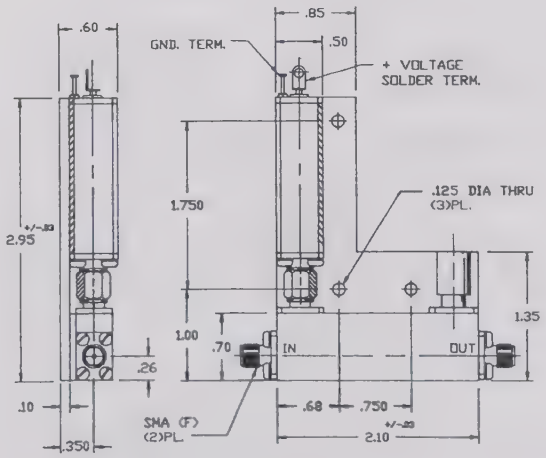
NC 3400 Series



NC 3404

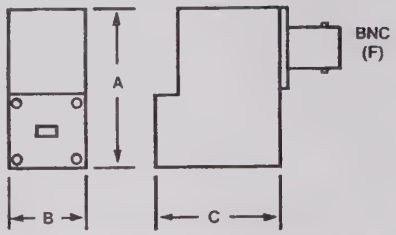


NC 3405, NC 3406, and NC 3407

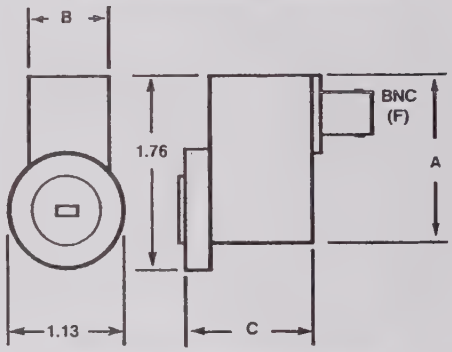


NC 3408

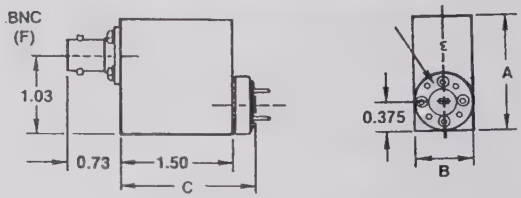
NC 5000 Series



WAVEGUIDE	A	B	C
WR-42	1.72	0.88	1.55
WR-28	1.58	0.75	1.30

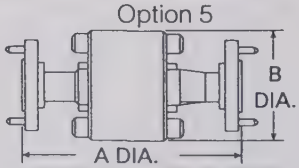


WAVEGUIDE	A	B	C
WR-22	1.51	0.75	1.31
WR-19	1.51	0.75	1.31



WAVEGUIDE	A	B	C
WR-15	1.50	0.76	2.00
WR-10	1.50	0.76	1.75

Option 5



	WR-42	WR-28	WR-22	WR-19	WR-15	WR-10
A	4.23	3.85	3.27	3.14	2.68	2.48
B	1.75	1.75	1.75	1.75	1.25	1.25

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Noise Com Communication Test Equipment

Noise Com manufacturers a complete line of test equipment for analysis and emulation of communication channels. The communication test equipment is used in the evaluation of CDMA, TDMA, FDM, frequency hopping, satellite, mobile, line-of-sight, and SONET systems. Each instrument is described in Noise Com's Communication Test Equipment catalog.

Precision E_b/N_o Generators

The UFX-BER Series for Bit Error Rate (BER) applications sets a precise ratio between a user-provided carrier and internally-generated noise. The UFX-BER uses the substitution calibration method to achieve accurate E_b/N_o or C/N ratios. It also allows setting of precise carrier-to-interference ratios.

Multipath Fading Emulators

The Multipath Series emulates a multipath fading communication channel. Rayleigh, Rician, and log normal fadings with 3, 6, 9, or 12 paths with Doppler shifts can be emulated in a fully-equipped system. The standard instrument has three paths, but up to 12 paths can be integrated into a single instrument. Digital signal processing ensures repeatability, small group delay distortion, and large dynamic range at RF and microwave frequencies without image or local oscillator spurs.

Amplifier NPR Test Stations

The UFX-NPR performs automatic intermodulation and spectral regrowth measurements using the Noise Power Ratio (NPR) method. The NPR method accurately emulates the loading of CDMA and FDM base stations, telephone networks, and satellite communication amplifiers with multiple carriers. It allows simultaneous display of gain and noise figure as an option.

Noise Figure Measurement Systems

The low-cost NCT Series instruments allow noise figure measurements to be performed accurately on a spectrum analyzer. It is possible to measure noise figure of narrowband receivers and cellular telephone components with the NCT Series because the frequency resolution is identical to that of the spectrum analyzer. Noise figure measurement range is from 0.1 to 25 dB.

E/S and Cell Site Monitoring Systems

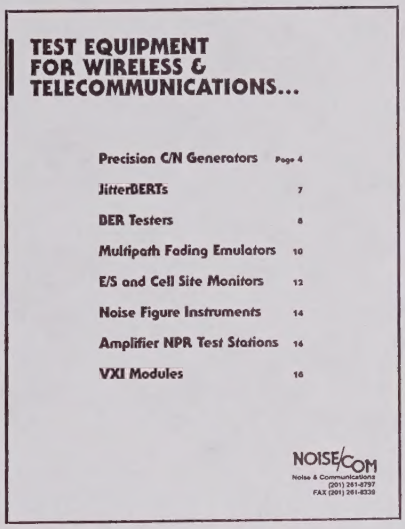
The Monitor Series monitors the performance of satellite, radar, and cellular telephone systems. Monitoring can be continuous on-line or triggered. One monitor can measure and display the noise figure, receiver gain, antenna VSWR, and transmitter power of up to six systems. These monitors are intended for built-in and rack-mount applications, as well as low-cost manufacturing and production test equipment.

VXIbus Noise Modules

These instruments are 10 Hz to 40 GHz programmable noise generators in C-size, double-slot VXIbus modules. They include amplified noise sources, step attenuators, optional switches for insertion of customer-specified filters, terminations, and combiners for signal and noise mixing.

Call For Your Free Copy...

Noise Com's Communication Test Equipment catalog is available from your Noise Com representative or by calling (201) 261-8797.



Certification

Noise Com, Inc., certifies that its products meet published specifications at the time of shipment from the factory. Noise Com, Inc., further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST) to the extent allowed by the bureau's calibration facility, and to the calibration facilities of other International Standard Organization (ISO) members.

Rights and Advises

Noise Com, Inc., reserves the right to make changes without notice in the devices or the device specifications identified in this publication. Customers are advised to obtain the latest version of the device specifications before placing an order to verify that the information relied on is current.

Specifications obtained in this publication supersede all data for these products published by Noise Com, Inc., prior to November 1993.

Warranty and Assistance

All Noise Com products are warranted against defects in material and workmanship for a period of one year from the date of shipment. Noise Com will, at its option, repair or replace products that prove to be defective during the warranty period, provided they are returned to Noise Com, and provided the preventive maintenance procedures are followed. Repairs necessitated by misuse of the product are not covered by this warranty. No other warranties are expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Noise Com is not liable for consequential damages.

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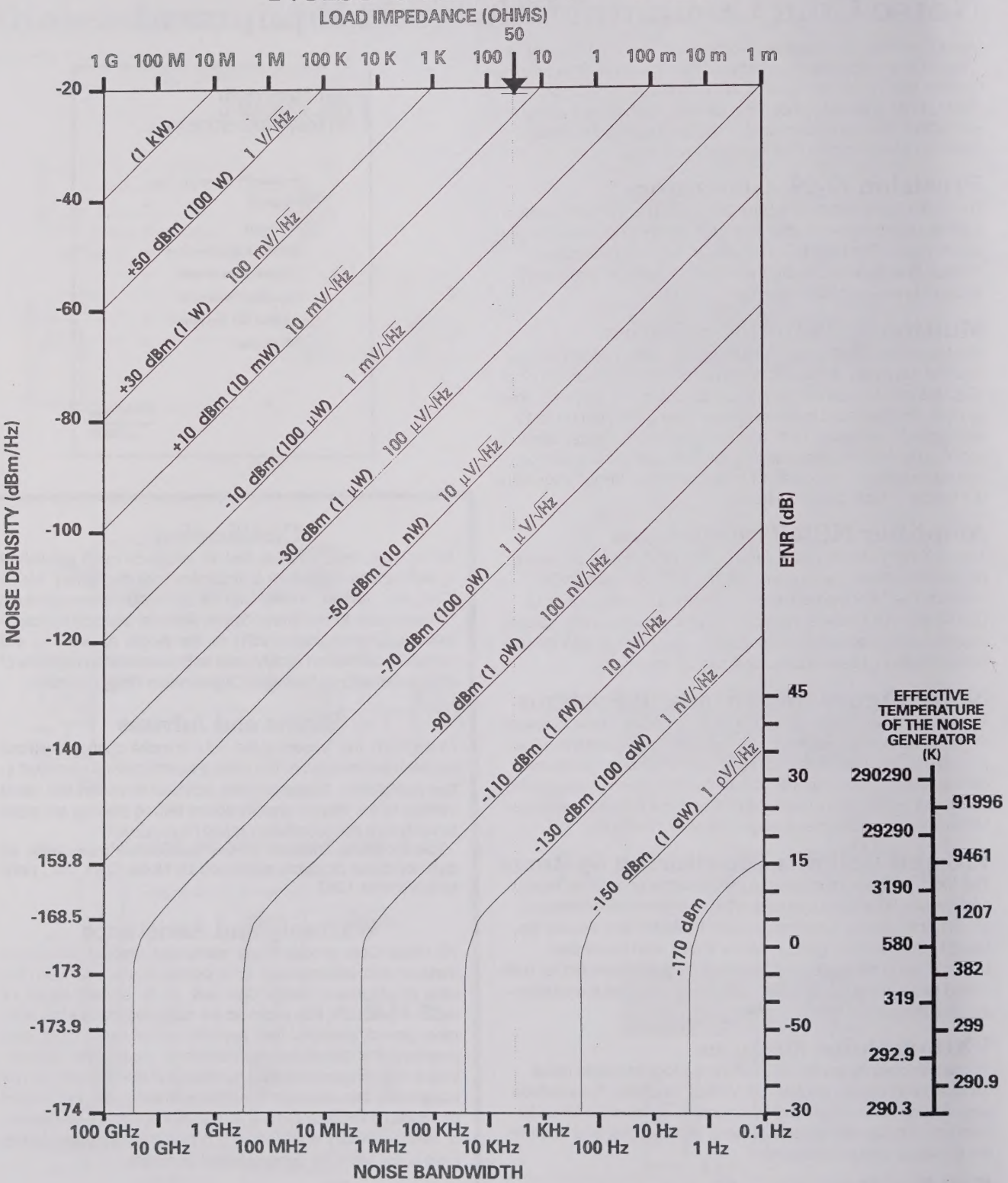
Noise Conversion Chart



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